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BULLETIN
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INTERNATIONAL RAILWAY CONGRESS
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INTERNATIONAL RAILWAY CONGRESS ASSOCIATION

13th SESSION (PARIS, 1937).

QUESTION VII.

Economical operation of the main-line systems' secondary lines. Various methods adopted to adjust the operating facilities, safety measures, and station organisation to the volume of traffic.

REPORT

(France and Colonies, Belgium and Colony, Luxemburg, America, China and Japan),

by Mr. GRANDJEAN,
Ingénieur en chef de l'Exploltation, Alsace-Lorraine Railways,

and Mr. GILMAIRE,
Ingénieur principal du service central de l'exploitation, Paris Orléans-Midi Railways Company.

We have been requested to report on this question for North and South America, Belgium, China, France, Luxemburg and Japan; we sent out 76 lists of questions to railway administrations in those countries, who are members of the International Railway Congress Association.

21 of them replied in detail to our questionnaire ; 22 replied that the list of questions was not of interest to them, either owing to their lines comprising no secondary lines or because their secondary lines were worked like their main lines; 4 promised replies which had not reached us when this report was written; 29 did not reply at all to the reporters.

The 21 detailed replies are from the following Administrations :

1. *Argentine Republic :* Buenos Ayres and Pacific Railway.

2. *Argentine Republic :* Central Argentine Railway.

3. *Belgium :* Belgian National Railways Company.

4. *China :* Lunghai Railway.

5. *U. S. A.:* Long Island Railroad.
6. » Pennsylvania Railroad Company.
7. » Reading Company.
8. *France :* State Railways.
9. » Alsace-Lorraine Railways.
10. » Est Railway.
11. » Midi Railway.
12. » Nord Railway.
13. » Paris-Orléans Railway.
14. » Paris - Lyon - Méditerranée Railway.
15. » Departmental Railways (Chemins de fer Départementaux).
16. » Chemins de fer Secondaires du Nord-Est.
17. *France (Algeria) :* State Railways.
18. » » Paris - Lyon - Méditerranée (Algerian Lines).
19. *French West Africa :* The Dakar-Niger System (A. O. F.).
20. *Japan :* Government General of Chosen, Railway Bureau.
21. *Luxemburg :* Guillaume - Luxembourg Lines (A.-L.).

Like the questionnaire, our report comprises 4 chapters :

1. Generalities.
2. Methods of transport used.
3. Safety measures applied.
4. Organisation of station services.

* * *

I. — Generalities.

In certain countries the term « secondary lines » is used for lines classified officially by the Public Authorities in this category. The conditions laid down for their construction are usually less rigorous than for the other lines, called main lines; the working regulations applied to them state notably — in certain instances, trains are only allowed to run at a low speed — that a very simplified system of signals can be used and that level crossings need not be guarded.

In the Argentine Republic, Belgium, U. S. A. and France [1], where such a classification does not exist, they call « secondary line » a line on which traffic is only light.

In the following pages the term « secondary line » is therefore synonymous with a line carrying only light traffic. In most instances secondary lines have only a single track.

All the Administrations who replied to our questionnaire have put into use, on secondary lines, regulations enabling them to reduce expenses for staff, track maintenance and guarding level crossings.

The exceptions made to the general rules are numerous but vary a great deal for each Management, because the equipment of the lines is in itself varying, and because the laws of the country allow the railways greater or lesser liberty to adapt the working to the traffic to be handled.

In France certain public secondary lines are worked by a Railway Company independently of the main line which holds the general concession. The stations are open to traffic on the same terms, but the managing company is not subject to the same laws as the main line; it can thus work at lesser expense.

The handing-over of the line is usually done by means of an agreement between the main line and the operating company, stipulating, as a rule, that the latter is responsible to the main line for all receipts (i.e. money taken). On the other hand, the main line is responsible to the operating company for the working expenses within a maximum lump sum. As an incentive to the operating company towards good management, there is granted to it, when receipts exceed a certain figure or when the actual working expenses amount to less than the

(1) Nevertheless, on the Alsace-Lorraine System, the public lines constituting this system were classified by the German authorities into main lines and secondary lines.

lump sum in the agreement, a premium in proportion to the increase of takings or reduction in working costs.

* * *

II. — Methods of transport used.

FRANCE. — Light trains.

For a long while past the French systems have been running, on their lines and particularly on branch lines, short or so-called « light trains ». The staff on such trains may be cut down to an engine driver and fireman on the locomotive, and one guard on the train.

When the driving of the locomotive does not require two men it is possible to dispense with a fireman (1), on condition that the guard stands or seats himself on the locomotive or has easy access to the latter whilst the train is running and is capable of stopping it should anything happen to the driver.

The French State Railways, for many years past, have been running 24 tank engines so fitted as to give access from the guard's van to the locomotive; the Alsace-Lorraine Railways equipped one such engine in 1932.

But the rolling stock in service does not always lend itself, at any rate without considerable and expensive alterations, to providing communication between the guard's van and the locomotive cab with sufficient safety for the staff. That is why certain lines have placed the guard on the locomotive.

The P.O.-Midi has, for this purpose, fitted a place for the guard. It has just equipped with cabins 16 locomotive tenders serving 385 km. (239 miles) of secondary lines and running some 1 100 km. (683 miles) per diem. The locomotives are of the *Columbia* 2-4-2 type, 590 H. P., total weight 44.6 it. (43.9 Engl. tons), adhesive weight 25.8 t. (25.4 Engl. tons); they can haul a load of 175 t. (172.2 Engl. tons) on the level at a speed of 90 km. (56 miles) an hour. The cabin is fitted at the front of the tender and its dimensions are : length 0.85 m. (2 ft. 9 1/2 in.), width 0.85 m. (2 ft. 9 1/2 in.), height 2 m. (6 ft. 6 3/4 in); inside it are fitted a folding seat, small writing table, pigeon holes for letters, rack for a lamp and lamp bracket.

Of course, this system would be unworkable if the guard had to issue tickets to passengers and check them whilst the train is running.

There are, at the present moment, in France, appliances which automatically bring a train to a standstill in case anything happens to the driver, but the tests have not yet been concluded, and for the present their use does not do away with the necessity for the guard being able to have access to the locomotive.

The fact of not having any fireman allows of a saving of 0.50 fr. to 0.75 fr. per kilometre being effected.

FRANCE. — Composition of light trains.

The French Railways have also tried to lessen expenses for traction and maintenance of passenger trains by adapting their composition to traffic requirements. We would first of all point out that, under certain circumstances, light trains do not need to have any

(1) The regulations state that a fireman may be dispensed with if the following conditions are fulfilled :

Locomotives must be fitted with an air pump and automatic brake-operating parts; in addition, and in the case of steam locomotives :

a) control parts must be within easy reach of the driver;

b) locomotives must have a supply of suitable fuel;

c) except with special permission from the higher authorities, the grate area must not exceed 2.75 m² (29.6 sq. ft.).

guard's van coupled between the locomotive and the leading passenger coach, whereas other trains in France must have one.

In order to simplify the composition of their trains, the French Railways have, generally speaking, done away with one class of coach on secondary lines. On such lines the number of 1st-class passengers was practically nil; it was, therefore, obviously the right thing to do to only provide one class for 1st and 2nd-class passengers; the compartments of this category have been marked I/II; they provide the comfort of the former 1st-class compartments.

Trains that are little used are often composed of one composite I/II—III coach, one or two 3rd-class coaches and a guard's van. In certain cases the train even consists of a single combined guard's van and passenger coach fitted out as follows : one I/II-class compartment seating 7 passengers, four 3rd-class compartments class seating 33 passengers and a compartment for the guard, 17 m² (183 sq. ft.) floor space, and having a loading capacity of 5 tons.

FRANCE. — Cost price of light-train-km.

Whereas the cost price per commercial kilometre, excluding writing off, of ordinary light trains varies between 6.65 fr. and 7.00 fr., the P. O.-Midi estimates this cost price for passenger trains of light composition drawn by a tank engine with cabin at 5.50 fr., i.e.

— Driving staff, fuel, lubricants, water	2.70 fr.
— Locomotice maintenance.	1.77 fr.
— Writing off cost of transforming tender	0.03 fr.
— Maintenance of rolling stock	0.65 fr.
— Guard	0.30 fr.
Total.	5.45 fr.
or	5.50 fr.

BELGIUM. — Reduction of train weights.

With a view to reducing the tonnage of trains as much as possible, the Belgian National Railways Company have done away with 1st-class on passenger trains running on secondary lines. They have also arranged the platforms of certain coaches in order to enable passengers to travel on them standing.

In order to avoid including a guard's van in trains when the volume of parcels to be carried does not require such a vehicle, they have transformed at a small outlay a compartment at the end of one coach on the train into a luggage compartment; they have simply removed the seats, fitted a cupboard and made the other little alterations needed by the guard to carry out his task easily.

ARGENTINE. — Trains running short distances.

The Buenos Ayres and Pacific Railway makes up certain trains, which only travel short distances, of single-class coaches.

*
* *

Locomotives of light trains.

From the answers received it appears, generally speaking, that the Administrations quoted at the commencement of the present report run on their secondary lines steam locomotives of a light type which were mostly used formerly on their main lines; none of these locomotives have undergone notable alterations for the purpose of using them to haul trains on secondary lines.

In France the use of steam trains having a small staff — an engine driver and a guard — has not increased much in the last few years, in spite of the large drop in traffic which hits the secondary lines very hard. When all is said and done, they have restricted themselves, when the present rolling stock enabled

an engine driver to attend to his locomotive alone, to making the few and inexpensive alterations necessary for this kind of working; they have not built any new rolling stock specially adapted for running with the help of one single man.

Railcars.

The French Systems have turned their main efforts towards the use of new vehicles, railcars, which, owing to their low kilometric running costs seem particularly adapted to an economical working of lines having only light traffic.

Improvements in the construction of petrol or diesel railcars have brought about a considerable development of operation by means of such vehicles, both on secondary lines and on main lines on which either accelerated local services or very fast services between large centres are carried out with railcars.

The number of internal-combustion engined railcars used on the whole of the French Railways increased :

from 61 units at the end of 1933,
to 228 » » » 1934,
and 377 » » » 1935,

and this progress will be continued in the coming years. The distances travelled by railcars amounted in 1935 to over 20 000 000 km. (12 400 000 miles), the daily average for the last three months reaching 68 500 km. (42 565 miles). Railcars are running over some 3 700 km. (2 300 miles) of lines carrying only light traffic.

According to the replies to the questionnaire, there are railcars in service on the secondary lines :

in the U.S.A. (Pennsylvania Railroad, 30; Reading Company, 14);

in Japan (Government General of Chosen — Railway Bureau, 29);

in Argentine (Buenos Ayres and Pacific Ry., 3);

in Algeria, 4.

The Belgian National Railways Company, which owns a large fleet of railcars, does not use this kind of vehicle on secondary lines.

Description of rail motor cars.

A technical description of rail motor cars in service on secondary lines would go beyond the scope of the present report; we would remind readers that the general question of rail motor cars from a constructional standpoint was discussed in a very complete report by Messrs. Dumas and Lévy, published in the August 1935 *Bulletin of the International Railway Congress Association.* We will restrict ourselves here to mentioning the essential characteristics, from a working point of view, of certain types of railcars used on secondary lines.

The railcars at present in service are almost entirely used for passenger services. They have, however, luggage compartments in which passengers' baggage is carried and often separate parcels as well (Appendix I).

The characteristics of the types planned to run on secondary lines have not yet been definitely decided. Nevertheless, it may be said that new railcars will have to possess :

— Sufficient capacity to meet amply normal requirements;

— High power to allow of a good commercial (overall) speed, and in certain cases of hauling a trailer (passenger coach or goods wagon);

— Reversibility, in order to lessen loss of time between arrival and departure at terminal stations;

— Possibility of coupling two railcars together, with a single control of the engines by one man (twin running).

As regards the conditions under which they will have to be used, it should be pointed out that railcars have engines which are sensitive to atmospherical changes and that they must, therefore, be housed in sheds, especially in winter, during the night.

Types of railcars used on French

Names of builders.	Overall length m. *(ft. in.)*.	Weight, empty. Metric *(English)* tons.	Type of wheels.	Passengers carried.		Parcels compartment.	
				Seated.	Standing.	Floor area M2 *(sq. ft.)*	Loading capacity. Kgr. *(lb.)*
							1. Petrol
Michelin	12.660 (41′ 6 7/16″)	4.8 *(4.7)*	Pneumatic-tyred.	24	...	6.0 *(64.6)*	360 *(793)*
Do.	13.900 (45′ 7 1/4″)	7.1 *(7.0)*	Do.	36	...	3.5 *(37.7)*	540 *(1 190)* 4 tip-up seats.
Do.	16.540 (54′ 3 3/16″)	9.8 *(9.6)*	Do.	56 incl. 8 tip-up.	...	3.5 *(37.7)*	840 *(1 851)*
							2. Diesel
Renault V. G. . . .	11.250 (36′ 11″)	11.0 *(10.8)*	Steel.	34	4	2.25 *(24.1)*	450 *(992)*
Entreprises Industrielles Charentaises	15.300 (50′ 2 3/8″)	10.2 *(10.0)*	Do.	50	12	10.0 *(107.6)*	1 000 *(2 204)*
Baudet-Donon-Roussel .	15.550 (51′ 1/4″)	18.4 *(18.1)*	Do.	38 (1)	19 (8 tip-up)	6.25 *(67.0)*	1 000 *(2 204)*
De Dietrich	18.120 (59′ 7/16″)	26.0 *(25.6)*	Do.	69	26 (6 tip-up)	4.25 *(45.5)*	1 000 *(2 204)*
Renault V. H. . . .	19.100 (62′ 8″)	27.5 *(27.1)*	Do.	42 (2)	34 (5 tip-up)	8.25 *(88.8)*	1 700 *(3 747)*
Renault A. B. J. . . .	25.910 (85′ 1/8″)	27.0 *(26.6)*	Do.	70	31 (4 tip-up)	8.25 *(88.8)*	1 500 *(3 307)*
Aciéries du Nord . . .	23.300 (76′ 5 23/64″)	36.0 *(35.4)*	Do.	68 incl. 4 in mail compartment.	16 (4 tip-up)	10.0 *(107.6)*	2 000 *(4 408)*
Standard (Est, Nord, P.O.-Midi)	24.700 (81′ 1/2″)	34.0 *(33.5)*	Do.	58 (3)	29 (4 tip-up)	9.0 *(96.9)*	1 500 (3 307) 4 tip-up seats
							Railcar in service on the Algerian
Société Centrale de Chemins de fer et d'Entreprises.	9.774 (32′ 13/16″)	9.0 *(8.85)*	Steel.	31 (4)	20	...	...
							Trailer in use on the Algerian
Do.	6.50 21′ 3 29/32″)	4.3 *(4.2)*	Steel.	42	...	...	...

ailway lines carrying light traffic. APPENDIX I.

Horse-power of engine.	Maximum hourly speed on the level, Km. *(miles)*.	Driver's compartments.		Can railcar be driven in both directions?	Remarks.
		Number.	Location.		
ngined.					
95	90 *(56)*	1	End.	No.	Single-class.
220	100 *(62)*	1	End, with look-out.	Yes.	Do.
250	110 *(68)*	1	Do.	Yes.	Do.
ngined.					
85	90 *(56)*	1	End.	Yes.	...
80	90 *(56)*	2	Do.	Yes.	...
120	100 *(62)*	2	Do.	Yes.	(1) 8 first/sec.-class and 30 third-class.
2 × 105	100 *(62)*	2	Do.	Yes.	Single-class.
265	97 *(60.3)*	2	Do.	Yes.	(2) 9 first/sec.-class and 33 third-class.
265	120 *(74.6)*	2	Do.	Yes.	Single-class.
280	122 *(75.8)*	2	Do.	Yes.	Do.
2 × 265	120 *(74.6)*	2	Do.	Yes.	(3) 19 first/sec.-class and 39 third-class.
ailways (metre gauge).					
90	60 *(37.3)*	1	End.	No.	(4) 14 sec.-class and 17 third-class.
ailways (metre gauge).					
...	...	...	...	...	...

On another hand, railcars must, for their current maintenance, frequently go through a depot suitably equipped and having a specialised staff.

Financial working results.

The improvement in the financial working results of secondary lines to be expected from the use of railcars is bound to have an effect on both sides of a balance sheet : receipts and expenses.

A) *Receipts.* — Receipts increase in proportion to the quality of the service ensured : with new commodities, there is a corresponding increase in the number of passengers because, without the former, certain passengers would use a competitive method of transport, or else not travel.

In this respect, working by means of railcars has the following advantages :

a) a rise in the commercial (overall) speed, 10 % to 25 % and over. This result is obtained :

by an increase in the maximum speed allowed on the line, which is permissible for railcars without having to improve the layout of the track and strengthen its equipment;

thanks to the great accelerations of railcars, which enable them to reach average speeds in the neighbourhood of the normal running speed, even with frequent stops; stops are moreover often reduced to less than 30 seconds and in certain cases an obligatory stop is even altered to an optional stop on request from a passenger;

b) the faculty of increasing the number of stops, without reducing the commercial speed too much, for serving localities along the line, which hitherto were served by a station a good distance away;

c) the possibility of increasing the number of trips without excessive expenses.

In France, on secondary lines worked by steam trains, there are usually only three trains a day in each direction; sometimes there are only two. The necessity for providing certain connections and the obligations imposed by the postal service entail local services often being carried out at inconvenient hours. A traveller is obliged to be away from his home for a long while in order to visit a neighbouring town, whereas he frequently only requires a short stay there for the completion of his business. Under the circumstances, it is not to be wondered at that road services easily took a large number of passengers away from the railways.

In order to regain or protect its traffic, a railway is obliged to increase the number of trips in order to enable people living in the country to visit towns and return to their homes during the morning or afternoon. Thanks to their lower kilometric running costs and to their technical qualities — speed and reversibility — which give a quicker turn-round than in the case of steam trains, railcars have in many instances supplied the economic solution to the problem.

Acting on the same lines, railways have, in certain cases where a large centre lies out of reach of a local line, avoided transhipment of passengers and considerably reduced the time taken for the journey by prolonging the trip of railcars, which serve secondary lines, as far as the large centre.

d) finally increased comfort, as the trains replaced usually consisted of rolling stock of old type.

B. *Expenses.* — As regards expenses, an essential element is the kilometric cost of trips. In railcar operation, as capital charges play an important part in this cost price, there is every inducement to obtain a good daily output from rolling stock.

In this respect, research made beforehand as to the periodical fluctuations in passenger traffic on lines on which one

proposes to replace steam trains by railcars is necessary.

Let us see what are, in effect, under this kind of working, the means used in France in order to cope with peaks of passenger traffic.

We would point out, first of all, that the railways have endeavoured to get a maximum use of the carrying capacity of each railcar, a capacity which must amply suffice for normal requirements. With this aim in view, railcars running on secondary lines often only have one kind of seat for passengers of the three classes; there are, at the utmost, in certain railcars, combined 1st-2nd class compartments, and 3rd-class compartments; in addition, the luggage compartment, in many instances, is fitted with folding seats or can have removable seats fitted in. Finally, seeing that it is almost always a case of short journeys, it is admissible that, within a limit to be laid down for each type of railcar, passengers may be carried standing.

When there is too large a number of passengers for one railcar, additional cars are put into service from one of the reserve depots.

Such reserves are also necessary for replacing vehicles that are out of service for current maintenance or repairs. Its relative importance depends upon the number of railcars in regular working; from this point of view it is wise to concentrate a comparatively large number of railcars in one and the same depot, using, for instance, the method of working with railcars for a whole group of lines radiating out from one centre. In actual practice, the extent of the reserve depot often amounts to 50 % of the total fleet. The resulting effect of this can be seen in the average length of daily runs.

Moreover, the running of additional railcars has, on single tracks, the drawback of disturbing the run of crossing trains, if general traffic regulations have to be complied with. That is why certain French Systems have adopted a special regime of duplicate runs at very short intervals, which we will go into further on when discussing safety measures applied on secondary lines.

Instead of running the regular railcar and the additional railcar separately, a better method is to couple them together. The new railcars are moreover fitted to be coupled together. Twin running, as is usually carried out at present on secondary lines, means that each railcar has to have its own driving staff; but, with a view to effecting economy as regards staff, appliances which enable the engines of both vehicles to be controlled from one driver's compartment are already in use on some railcars, or being perfected.

It would clearly be desirable, when it is not possible to place all the passengers wishing to travel in one railcar, to be able to couple up to the railcar one or several passenger coaches to be trailed, rather than another railcar. So far, this method has hardly been used on secondary lines, above all because the railcars now in service have not sufficient power to reach, with a trailer, the high commercial speed obtained from one single railcar on a local service. But certain railcars which will shortly be put into service on secondary lines will, thanks to their excess power, be able to handle a trailer without the drawback mentioned. This faculty, of interest to passenger traffic will, moreover, provide great conveniences for the forwarding of express consignments on secondary lines not served by parcels trains when all passenger trains will have been replaced by railcars.

The various methods now in use would not permit to meet all traffic peaks without necessitating a very considerable reserve depot; steam motive power has, therefore, always been kept in reserve, to which recourse may be had in case of need. Replacing a railcar by a steam train is, moreover, not without

drawbacks owing to delays which are often considerable, because a train cannot possibly keep to time.

To sum up, as railcars have a restricted carrying capacity and insufficient or no haulage power — at any rate as regards a large number of railcars at present running on secondary lines — and in view of the necessity for the railway to handle all the traffic offering, the companies were compelled hitherto, with irregular passenger traffic, to have a large number of railcars in reserve or often fall back upon steam traction. This situation is likely to improve in the future if the question of railcars hauling other vehicles can be suitably solved by using powerful units.

FRANCE. — Cost price per railcar-kilometre (vehicles of various types).

We give below the cost price in French francs per kilometre *(per mile)*, in 1935, of a few types of railcars carrying on, in France, a local service (the staff comprising 1 driver and 1 guard) :

—	Steel-tyred railcars.		Pneumatic-tyred railcars.	
	42 seats, 34 standing.	69 seats, 26 standing.	36 passengers carried.	56 passengers carried.
Depreciation reckoned on a total run of 500 000 km. (310 000 miles) (local service).				
Daily average runs made in 1935	200 *(124)*	230 *(143)*	190 *(118.1)*	220 *(136.7)*
Cost price : traction and overhead expenses :				
Driving staff. Fuel and lubricants. Current maintenance. Heavy repairs.	2.34 *(3.77)*	2.55 *(4.10)*	2.88 *(4.63)*	2.54 *(4.09)*
Supplement for subsequent heavy repairs.	0.50 *(0.80)*	0.75 *(1.21)*	0.30 *(0.48)*	0.50 *(0.80)*
Amortization of vehicle . . .	1.01 *(1.62)*	1.34 *(2.16)*	0.91 *(1.46)*	1.23 *(1.98)*
Guard	0.26 *(0.42)*	0.26 *(0.42)*	0.26 *(0.42)*	0.26 *(0.42)*
Cost price in French francs (round figures) per kilometre *(per mile)*	4.10 *(6.60)*	4.90 *(7.90)*	4.35 *(7.00)*	4.55 *(7.30)*

The cost price of a light train replaced may be estimated at 6.65 to 7 fr. per km. (10.70 to 11.25 fr. per mile), not taking depreciation of rolling stock into account, which is justifiable in most instances; a comparison of these cost prices shows a saving of about 40 % in favour of rail motor cars.

* * *

Selection of lines which can be served by railcars.

But a study for replacing passenger trains by railcars cannot be restricted to passenger traffic; one must also take goods traffic into account.

In order to do away with all steam passenger trains it is necessary, in effect, that express goods traffic should be light if it is to be carried by railcars,

that it should exist at the time of running a goods train kept in function or, finally, that it should, on the contrary, be sufficiently important to justify the use of a specialised parcels train.

Of course, one can only partly replace steam passenger trains by railcars, but one must not lose sight of the fact that in order to use rail motor cars rationally it is necessary that their running should be so timed that it gives a good daily mileage and is in keeping with the regulations concerning the use of staff. It is necessary, on the other hand, that trains replaced should be judiciously selected if their suppression is to leave sufficient profit from the alterations in locomotive workings.

From the manner in which all these conditions are fulfilled depend any real savings that may be gained by the substitution of railcars for passenger trains. This substitution cannot be declared advantageous *a priori;* the question requires, in each particular case, a careful study of the consistency of the traffic on each line and its periodical fluctuations, both as regards passengers and goods.

FRANCE. — Results obtained on 3 lines worked by railcars.

By way of information, the following are the characteristics of railcar operation on the P.O.-Midi Railways (Mont-de-Marsan Centre, an agricultural district), and the results obtained :

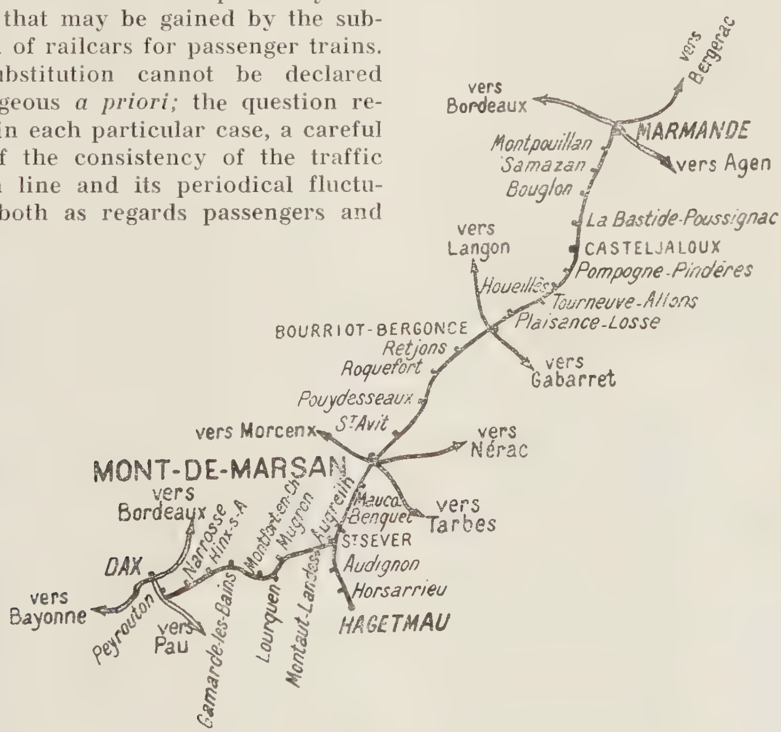
Lines worked by railcars (see map, Appendix II).

Mont-de-Marsan to Marmande = 64 km. (39.8 miles).

Mont-de-Marsan to Dax = 98 km. (60.9 miles).

Saint-Sever to Hagetmau = 15 km. (9.3 miles).

Prior to 1st August 1933, the service



Appendix II.

was worked by steam trains under the following conditions :

Passengers :

Mont-de-Marsan to Marmande : 3 return journeys per diem.

Mont-de-Marsan to Dax : 3 return journeys per diem, plus 1 return journey a day Mont-de-Marsan to St.-Sever.

St.-Sever to Hagetmau : 4 return journeys per diem; or in all 1 112 train-km. (690.3 miles) per day.

Goods :

1 return journey per day on each line, or 386 train-km. (240 train-miles).

In 1935, all the passenger trains were replaced by railcars and the passenger service comprised the following runs :

Mont-de-Marsan to Marmande : 4 return journeys a day plus 1 return journey on the partial runs Mont-de-Marsan to Bourriot-Bergonce, Casteljaloux to Marmande.

Mont-de-Marsan to Dax : 5 return journeys a day, plus 1 single trip Mont-de-Marsan to St.-Sever.

St.-Sever to Hagetmau : 5 return journeys per diem; or in all 1 716 railcar-km. (1 066.3 railcar-miles) a day, or when compared to the previous steam trains an increase of 54 %.

The railcars used were supplied by the « Entreprises Industrielles Charentaises » (characteristics : 80 H.P., 50 passengers seated, 12 standing, one class only, luggage compartment 10 m² = 107.6 sq. ft., holding 1 000 kgr. [2 200 lb.), maximum speed on the level 90 km. (56 miles), reversible].

The steam goods service was maintained without any change; it is used not only for forwarding slow goods traffic but also for express goods which cannot be loaded into the luggage compartment of the railcars.

The fleet of railcars is made up of 10 units required according to the timetables; taking into account the reliefs (8.2 %), the annual total run is 680 000 km. (422 540 miles), or on an average 186 km. (115.6 miles) per railcar (including the reserves) per day.

On certain days (fair and market days) when there is a large number of passengers steam trains have to be run; the distance travelled by these trains amounted to 6 150 km. (3 820 miles) in 1935, or 0.9 % of the runs of the railcars.

The time taken for the run from Mont-de-Marsan to Marmande, 2 h. 25 m. by steam train, has been cut down by 30 minutes, viz. by 20 % [commercial speed 51 km. (31.7 miles) an hour, with 14 intermediate stops on a run of 98 km. (60.9 miles)], and on the run from Mont-de-Marsan to Dax, 1 h. 45 m. by steam train, the gain is 25 minutes (24 %).

The cost price of the rail motor cars is about 4 fr. per km. (6.40 fr. per mile) including amortization of the special installations which were created at Mont-de-Marsan for housing and maintenance of these cars (shed, workshop, inspection pit, tanks for storing fuel and lubricants), and which cost 20 000 fr.

The short steam train which ran on these lines before the railcars were put into service worked out at about 6.75 fr. a kilometre (10.85 fr. per mile), exclusive of depreciation. Seeing the increased distance run : 680 000 railcar-kilometres instead of 399 600 train-kilometres, the expenses before and after transformation of working come to about the same.

Passenger receipts (not including passengers from beyond) increased from 893 823 fr. in 1933 to 1 107 368 fr. in 1935, or an increase of 213 545 fr. (24 %). But one should take into account the fact that on the neighbouring lines, on which steam traction was still in use, the traffic dropped during the same period; this drop was 13 % on the line from Mont-de-Marsan to Nérac, which had a quite comparable traffic; the P.O.-Midi proposed, moreover, to run railcars on this line on and after 1st July 1936, connecting it to the Mont-de-Marsan Centre. On the lines men-

tioned, the drop calculated on this basis would therefore have amounted to 116 200 fr.

From the preceding figures it would appear that it would have been more advantageous to replace, unit for unit, trains by railcars.

As a matter of fact, it was necessary to spread the passenger and parcels traffic over a greater number of railcar runs than that of trains replaced.

Moreover, it should be pointed out that the timetables of the services run ought to have been drawn up in such a manner that they gave the maximum of convenience for travellers, viz. it would have been impossible to space them, according to lines and the direction of traffic, in such a manner as to considerably lessen the fleet of railcars running regularly; there would have resulted, on the contrary, a considerable drop of the daily kilometres covered, and consequently a rise in the kilometric cost price of the railcars.

* * *

III. — Safety measures applied.

Level crossings.

Let us first of all go into the particular question of level crossings. There exist, since the construction of for a number of years past, on the secondary lines of most of the Administrations interrogated, level crossings that have no barriers and which are unguarded. The item of expenses for guarding remains, nonetheless, often a very heavy one, and endeavours are being made to do away with guarding at other level crossings. The requisite conditions for this elimination to be permissible are, as a rule, that road traffic should only be light and that road users may be aware of the approach of a train sufficiently far ahead.

The rules in force vary according to countries.

In France, on the Alsace-Lorraine Railways, which have a separate and particular régime for their secondary lines, the dispensing with barriers does not, on principle, mean the observing of a speed limit near level crossings. But they take into consideration the time during which the fastest train is, from its appearance until it reaches the level crossing, visible to the driver of a road vehicle near and at a certain distance from the level crossing. On the level crossing this duration of visibility must be at least 20 seconds.

Signs are placed on the road to warn users of the existence of a level crossing; at some level crossings this sign-posting is supplemented, as a test, by winking lights that change colour to announce the approach of trains. When a train approaches a level crossing, two signs placed on either side of the crossing automatically show rapidly-winking red lights, which change to slow-winking white lights as soon as the train has cleared the level crossing. As the cost of installation and maintenance of these signals is fairly high, it is proposed to only use them in cases where they are of real necessity.

Finally, the obligation to whistle is often imposed on trains approaching an unguarded level crossing, and a special signal on the spot reminds drivers of this.

The French Railways are considering the suppression shortly of barriers at a large number of level crossings.

On lines where the working has been simplified, the Belgian National Railways Co. has done away with keepers at certain level crossings which were guarded hitherto. At these level crossings the following safety measures are observed :

(1) driver of train is obliged to take his precautions to only cross the level crossing at a reduced speed and to be even able to stop if he sees that the way is obstructed.

(2) driver must whistle on approaching a level crossing and continue to whistle until the locomotive and tender are clear of the crossing.

(3) installation of a lantern giving a red light at night, in addition to the road signs prescribed for unguarded level crossings.

Finally, several Administrations report that they use bells worked automatically by the trains, to announce their arrival.

And in a general way, hedges have been cropped, trees felled, small houses demolished, etc., for the purpose, when necessary, of improving the visibility of a line near level crossings, when the elimination of barriers was carried out.

Technical working of secondary lines.

As regards the technical working of secondary lines, we would remind readers of the shuttle method of working, which has been used for a long while past on lines carrying only a very light traffic and which enables companies to do away with all signals on the line and station staff. We will give a description further on of the methods of simplified working used more recently.

The French Railways use, on a large number of single-track secondary lines, simplified methods of working which have enabled them to considerably lessen the number of signals on such lines.

When signals are not completely done away with, notably in stations where trains may cross or overtake one another, the signals that have been retained or marker panels replacing them, and which it is necessary to light, are usually placed a short distance away from the incoming points.

A saving has thus been effected on previous expenses entailed by lighting signals, owing to a lesser number of lanterns on the one hand and the suppression or reduction of work for lighting and extinguishing signals on the other hand.

In addition, as the French Systems are altering their signals by substituting green lights for white ones to show « line clear », the elimination of a certain number of signals has the advantage of saving the cost of such alterations to the signalling.

On the French State lines, stations having simplified signalling (2 872 km. = 1 795 miles on 15th May 1936) are not protected by fixed signals; they are protected, at either end, by a distant signboard, not lighted at night, showing the word « Station » to trains approaching such stations, and a special signal post, lighted at night, placed 100 m. (110 yards) ahead of the approach points.

All stations are general stopping points for all runs. Drivers passing a « Station » signboard must take their precautions to be able to stop when they reach the special signal post, if required; beyond this post and up to the usual stopping point in the station drivers are only allowed to run at a sufficiently reduced speed to be able to stop before reaching any obstacle that may be on the track. The speed for running over points in stations is, moreover, absolutely restricted to 30 km. (18.6 miles) an hour for trains fitted with continuous brakes and carrying passengers and 15 km. (9.3 miles) for other trains.

Points in stations usually have free counterweights; the approach points are usually locked so as to give access in both directions to one single track.

When crossing, each train must, on principle, enter by the left-hand track : for this purpose, 10 minutes at least before the normal arrival-time of the first train, the station master must unlock the two sets of entry points and arrange each of them to give access to the lefthand track. The approach points being released and not maintained, each of the trains must, before reaching the approach points make a stop at the special sign post.

For normal crossing, no special steps need be taken : the driver must stop of his own accord and the guard gives, as soon as the train has stopped, and if there be nothing to prevent same, the order to enter the station.

In the case of an exceptional crossing, the station master must place at the special sign post a removable stopping-signal, in addition to detonators; this stopping signal is only removed after the train has stopped.

The interval between trains is kept by telephonic working of block sections.

Trains which have come to a standstill on the open track must be protected, the minute they have stopped, in the usual manner ordained by the regulations; however, a train that has stopped at the special sign post of a station need not be protected when the duration of the stop does not exceed 5 minutes. Protection in stations is ensured by the obligation to run at sight imposed on all trains from the stopping post onwards.

Any shunting can be carried out on the main track without special protection, on condition that the track can be freed at least 5 minutes before the normal arrival time of the train, if the shunting takes place between the special sign posts, and 15 minutes if it takes place beyond them.

If owing to unforeseen circumstances, the main track cannot be freed within the desired time and if the length of track occupied is between the special sign posts of the station, the employee supervising the shunting need only make the obstacle visible towards an incoming train : vehicles standing on the main track are considered as visible by day; the obstruction they form is made visible at night by a red lamp placed towards an incoming train.

On most of the other railways, lines subject to simplified working are split up into block sections limited by stations having full safety appliances. Intermediate stations only have one track used for the running of trains; no crossing nor overtaking can take place in them.

In the intermediate stations, as a rule, signals are done away with and no safety operations are performed in them which require the services of station staff. In certain cases, the management of such stations has been handed over to persons who do not belong to the railway staff and who, in return for the very slight service they have to perform, are satisfied with a much lower remuneration than what an official employee would receive. This question will be referred to further on when dealing with station organisation.

For shunting at intermediate stations, the guard frees the points, either with the aid of a single key for all stations in a block section (which is given him before the train starts), or else with the aid of keys deposited in such stations and retained under the responsibility of those in charge of the station.

The P. O.-Midi Railways, for instance, have eliminated all signals at intermediate stations; generally speaking, they have reduced the signalling of block-terminal stations other than line terminal stations to a fixed stopping-signal placed a short distance away from the approach points, called a « crossing signal » (P.O.), or to a marker plate, lighted at night, bearing a black stripe on a white background (Midi). The approach to a place having no distant signals is brought to the notice of drivers by white painting, to a height of 2 m. (6 1/2 ft.), on the telegraph poles situated within the 500 m. (550 yards) preceding such a point.

At terminal stations of blocks the points have their counterweights in the position opening the left hand track; on the contrary, at stations which are not block-termini, the position of the entry points is such as to open only the single track on which trains run and they are locked.

Drivers of all trains approaching a block-terminal station are ordered to so regulate their speed that they can stop at the crossing signal, if the latter is closed, or at a movable stopping signal placed near the marker panel and then only to pass this open crossing signal or the marker panel at a sufficiently reduced speed to be able to stop easily in the station. In addition, drivers are in no cases allowed to run over the approach points at a speed exceeding 30 km (18.6 miles) an hour.

The speed of trains is, moreover, limited to 30 km. an hour between the end points of all stations having no signals or not having the complete equipment fitted on lines that work under normal conditions.

When crossing takes place in a block-terminal station, steps are taken in order that two trains only enter the station successively. To the second train which is due, the crossing signal in the « stop » position is shown or a movable stopping signal is placed at the marker panel as long as the first train has not reached its final stopping place.

These lines on the P.O.-Midi (1 695 km. = 1 053 miles) are worked by train-staff, one train-staff being used for each block section. On blocks in which it is necessary to run two trains consecutively in the same direction, which is usually the case, the train-staff is provided with two tokens which can be separated from the staff; the train-staff and the tokens have engraved on them, on a copper plate, the names of the two extreme stations between which they are valid.

One of the tokens is used for the up direction and the other for the down direction. A locking prevents the two discs from being removed from the staff simultaneously.

When two trains have to enter one block section consecutively, the station master hands to the driver the token corresponding to the direction, showing to him at the same time the staff.

Trains are not protected whilst at a standstill on the open track nor during halts at places served.

Spacing between the train carrying the token and the train carrying the staff and running behind the former is ensured by means of absolute telephone blocking.

Exceptionally, in case of interruption of telephonic communications, the second train is authorised to enter the section on which the first train is running, after the driver has received a written order allowing him to drive at a speed at which he can always stop on sight of an obstacle and mentioning the points at which the first train makes a regular stop; on approaching such points, drivers must not exceed 20 km. (12.4 miles) an hour.

At stations where there is no signalling or restricted signalling it is forbidden, on principle, to carry out any shunting on the main lines in between the trains; if, exceptionally, it is necessary to do so, the shunting must be protected at each end at the regulation distance. In stations that are block-termini, if the shunting area is not to exceed a point situated 100 m. (110 yards) within the crossing-signal or within the marker panel, it is protected by a movable stopping signal placed at the marker panel. Of course, if the block-terminal-station holds the train-staff appertaining to one direction, protection in that direction is not obligatory, unless a pilot engine is expected.

Thanks to the use of train-staffs, the safety measures to be observed for releasing a special or supplementary train are very much simplified : the release of such trains is subject to authorisation by an appointed station master whose role consists in taking the necessary precautions so that, in each block section, the movements of the train-staff and the tokens allow trains to adhere to their standard timetable.

The Belgian National Railways Co. applies a simplified method of working,

the provisions of which, concerning signalling of single-track lines, are as follows :

1. All warning signals on the line have been done away with. Nevertheless, when the approach signals to a station have been retained, the visual approach indicators (wooden boards) which preceded warning signals of such a station have been retained.

2. In crossing stations :

a) If the crossing system is applied throughout the year, for the whole duration of the service, the signalling comprises fixed home signals and fixed starting signals;

b) If the crossing system is applied throughout the year, but only during part of the day, fixed starting signals are no longer used; in case of crossing, movable signals are used (flags or discs).

The home signal plays the part of a distant signal with regard to the movable starting signal. When it is necessary to stop, at the movable starting signal, a train which normally does not stop at the station, it has first to be stopped at the home signal.

During the period in which the crossing régime is not applied, the home signal is kept at « line clear » and the running of trains in the station takes place normally on a single track.

c) If the crossing system is only in force during part of the year (for seasonal traffic), the signalling is the same as in the foregoing case. During the period in which the crossing system is not applied, the arm of the home signal is removed and the running of trains in the station is carried on normally on one single track.

In cases *b*) and *c*), when the régime of crossings is applied, one track is used for each direction.

The station master is personally responsible for putting the points in the proper position and for their locking.

The locking and unlocking of leading-in points at crossing-stations are frequently controlled from a distance so as to allow the exit of crossing trains without the help of an employee at each end of the station.

3. In stations where crossings can never take place, all signals have been done away with.

In stations or halts without any signalling the points are kept in the normal position with the aid of locks the keys of which are deposited in the neighbouring crossing stations, where they are in charge of the station masters. Particular regulations govern the handing over of keys to guards who have to shunt, and their being handed back to the crossing stations.

The telephonic block system is used for trains run in succession in the same direction; only those stations which have retained signals intervene in the block service. Safe in exceptional circumstances, trains on the open line have not to be protected.

On the Pennsylvania Railroad, lines carrying light traffic are generally worked under the normal manual block system. Nevertheless, at certain particular points, the distant signals are fixed in the warning position; tables for controlling the warning and stopping positions are also used.

Running on the secondary lines is, as on the main lines, directed by a dispatcher, but on the secondary lines certain block signal boxes are abandoned. These are shown by a marker post. Trains have to stop at it and the guard has to get into telephonic communication with the block-signalman at the station to which belonged the eliminated box, for giving or receiving information as to how the lines are occupied. The orders of the dispatcher are transmitted to the guard by the block-signalman of the block station which thus fulfils the functions of block-signalman of the abandoned block signal box.

The dispatching system has been installed in France on only one secondary line : the line from Chartres to Massy-Palaiseau (71 km. = 44.1 miles) worked by the State Railways. Safety is ensured by direct exchanges of telephonic communications between the dispatcher and guards; in addition, in stations where crossings or overtakings can take place, there has been installed, for each direction of traffic, a starting signal, the opening of which is controlled from the dispatcher station. This signal closes itself automatically as soon as the train has passed over a pedal placed at the exit of the station. All the stations on the line are managed by women. The application of this equipment to other secondary lines is not being considered, as the State Railways apply to them the régime of simplified signalling described at the start of the present chapter.

Particular cases of lines served by railcars.

On lines worked by railcars we have pointed out that certain French railways, in order not to disturb too much the running of trains in an opposite direction, dispatch a relief railcar at a short interval after the preceding one.

On the Midi system, for instance, this interval has been reduced to 3 minutes (or 5 minutes when the first railcar has had to be replaced, exceptionnally, by a steam train).

Safety of the traffic is obtained by :

1. Enforcing the telegraphic block system between two runs in the same direction. In order to apply this rule, the regular railcar and the extra railcar are considered as one trip.

2. Obliging extra railcars to run cautiously and slow down to 60 km. (37 miles) an hour on sections where visibility ahead is less than 150 m. (165 yds) and to 40 km. (25 miles) an hour on sections where such visibility is less than 100 m. (110 yds).

3. Requiring the railcars to be fitted with an appliance automatically signalling any braking, by means of a luminous signal placed on the rear of vehicles.

Whereas the regular rule is to dispense with any protection of railcars or trains at a standstill on an open track, protection of railcars is obligatory in the case of an incidental stoppage beyond the protection of station signals, when such railcar is followed by an extra railcar. The employee entrusted with the protection has to place two detonators on the track 200 m. (220 yards) from the point of stopping and then return to his railcar.

Zones in which extra railcars have to slow down owing to insufficient visibility ahead are shown on the track by painting, to a height of 1.50 m. (5 ft.), either the telegraph posts or else square stakes implanted alongside the track; this painting is done in white in zones where visibility is less than 150 m. (speed limit 60 km. p. h.) ; it is done in 3 alternate stripes : 2 white and 1 black, in zones where visibility is less than 100 m. (speed limit 40 km. p. h.).

Lighting of signals.

Except on lines where no night traffic runs, the signals retained are usually lighted at night.

In France, on lines on which railcars run, sign boards intended solely for railcars are not, as a rule, lighted at night; sometimes sign boards restricting speed and raising same have been fitted with reflecting devices (cat's eye reflectors rendering the figures very apparent in the glare of the railcar's headlight).

The Belgian National Rys. Co. are at present carrying out tests for the purpose of fitting such reflectors to the S. F. (or « Whistle ») posts which precede unguarded level crossings and for fitting locomotives with an acetylene headlight, to be used only when they are running on lines that have an elementary

working. On such lines sign boards indicating speed limits have been suppressed.

Various particularities of technical working.

In stations where there is no longer any official staff to carry out running operations, shunting is controlled by the guard and the points are worked by the train personnel. In Belgium the fireman helps in shunting and handling operations; shunting can be done without the fireman being on board the engine. In such stations the Administrations who do not have the cleaning and oiling of points done by track supervising staff have entrusted this work to the staff of goods trains which have to shunt there.

* * *

IV. — Organisation of station services.

Stations on secondary lines are open to passenger, baggage, parcels (express), ordinary goods and full wagon load traffic on the same terms as stations on the main lines, the period the station or halt is open only depending on the amount of traffic in the locality or region served by the station.

In the U. S. A. and France, the opening to the public of certain small stations is restricted, however, to certain hours of the day (viz. hours at which trains pass or at which there is always a demand).

Transport of goods.

On secondary lines goods are carried according to rules that are almost identical in the case of all the Administrations interrogated. These general rules which are, moreover, in most cases those appertaining to the main lines are as follows :

a) *Small consignments.* — These are usually carried on the first available train, either passenger or goods train.

b) *Full wagon loads.* — On secondary lines having a lively full-wagon load traffic, one or more goods trains run daily in each direction.

If traffic is less intensive, goods trains only run on certain days of the week (say 2 or 3 times a week).

On lines with only very light traffic goods trains are not run. *Mixed trains* carrying passengers and complete wagon loads, are run on timetables arranged in such a manner that wagons may be dropped or picked up at intermediate stations.

Weighing of goods.

For the weighing of goods the methods followed by all the Railway Companies are the same on secondary lines and main lines.

Small consignments are weighed on scales which all the stations possess. Complete wagons are weighed on weighbridges with the aid of the locomotives and staff of passing trains. When departure stations have no weighbridges the weighing is done at some neighbouring depot.

It is of interest to point out here that on the lines of the Buenos-Ayres and Pacific Railway the weight declared by the consignor at the departure serves as a basis for charging up, and it is only on arrival, after weighing, that any necessary adjustments are made.

The Long Island Railroad and the Pennsylvania Railroad (U. S. A.) do not check weights when the shipments are made by firms known to be reputable and with whom these Administrations have made weight-agreements.

Assessment of goods.

The assessment of consignments is done in various ways according to the methods adopted by the railways.

Certain Administrations [Cie des Chemins de fer secondaires du Nord-Est (France), Algeria (State Railways and P. L. M.) and Japan] have maintained

the same regulations as on the main lines. All the stations assess their goods forwarded.

Some Administrations (Belgian National Railways Co., Central Argentine Railway, Buenos Ayres and Pacific Railway and Reading Company) have simple assessments made by stations on secondary lines, but the more complicated ones by central depots or stations.

And, finally, many of the other Administrations (Long Island Railroad, Pennsylvania Railroad, all the large French railway systems and the Railways of French West Africa) have initiated a method of assessment by one centre station, this assessment being often only part of a simplified system of assessment and bookkeeping introduced not only on secondary lines but also on the main lines at small stations and halts where there is only light traffic.

Simplified methods of assessment and accountancy.

After studying simplifications made in their station accountancy by other French railway systems, and more especially by the Est Railway, the Alsace-Lorraine Railways put into force on 1st March 1935 a method called « simplified book-keeping ».

Normally, on all the French systems, the operations of assessment and accountancy for all kinds of traffic (Tickets — Baggage — Parcels and other goods) are done by the forwarding or receiving stations. The so-called « simplified book-keeping » régime enables them, in all stations where the work to be done does not entail the whole time of an employee, to do away with most of the operations of assessment and accountancy, by transferring them to a more important station called a « gare centre comptable » (accountancy centre-station).

On the Alsace-Lorraine System a real district accountancy has thus been set up.

The stations subject to this régime are necessarily connected by *telephone* to the accountancy centre-station, and placed in charge of managers (« gérants ») or manageresses ensuring a service at *fixed* periods coinciding with the passing of trains and at *variable* periods fitting in with the requisite time for informing or serving the public.

The contract made between the railway and the manager is a hire-agreement.

The manager may be authorised by the head of the centre-station to be helped or replaced by a member of his familly or any other person for whose actions he stands a pecuniary guarantor.

The railway company places at the disposal of the manager a house and garden and gives him a monthly remuneration according to the size of the establishment and the amount of work to be done.

The duties of the manager are reduced to a few simple operations : issue of tickets, registration of luggage, drawing up consignment notes, weighing, reception and delivery of goods, keeping a statement of daily takings and disbursements. (In certain cases, working the barriers of level crossings where there is not much traffic).

As regards the carrying out of these duties, a few peculiarities may be mentioned :

a) Passengers. — The manager is supplied with a table which enables him to calculate the price of tickets for the runs most used; for other journeys the ticket is issued either by the manager, if he has had time to obtain the price by telephone from the centre-station or, in the contrary case, by the guard on the train.

b) Luggage. — The manager registers and labels all luggage that is not excess-baggage, and excess-luggage for places most travelled to; in other cases he proceeds as in the case of tickets.

c) Dispatching of goods. — On principle, simplified-accountancy stations open to goods traffic are not supplied with way bills of the kind supplied to all stations.

Unless the consignor hands in a way bill or invoice of the regulation type he must fill in a special form called « *Bulletin de remise au chemin de fer* » (handing in note), which replaces a way bill.

The « bulletin de remise » is made out by the manager when the consignor hands in a consignment note, a waybill, or an international dispatching note.

This bulletin has 4 carbon copies (numbered 1 to 4) (see Appendix III) (1) :

1. The counterfoil (« souche ») to be kept by the manager;

2. The handing-in note (« Bulletin de remise ») to be sent to the centre-station after having added to it, in case of need, the consignment note or waybill;

3. The provisional invoice (« feuille provisoire »), which accompanies the goods as far as the centre-station or destination, if the goods do not travel via the centre-station;

4. The provisional voucher (« Récépissé provisoire »), to be handed to the consignor, who exchanges it ultimately, if he considers it necessary, for a final receipt issued by the centre-station.

The manager is supplied with a table showing the carriage rates for goods usually sent from his station and for the most frequently used destinations. For other destinations he asks, by telephone, the centre-station for the amount carriage paid or carriage forward, if the consignor wishes to know same; in case of need he also requests authority to pay out a sum.

As soon as each train has arrived the centre-station collects the handing-in notes and completes the regular accountancy.

d) Arrival of goods. — Arrivals are booked in its own accounts by the centre-station which keeps consignment notes, way bills etc. on arrival but sends receipts or international waybills to the simplified-accountancy establishment after stamping them $\boxed{\text{Verified}}$. If this stamp is missing, it means that the centre-station has not had time to do the booking (or entry). In that case, concordance of the rate entered on the receipt and that which appears on the way bill is verified either by the centre-station or by the guard, and it is the latter who hands the receipt to the manager; before delivering the goods, the latter must ask, by telephone, the centre-station if the rate is correct. Delivery of goods is effected by signing a delivery-sheet (see Appendix IV) of which the reverse side is only filled in by the manager in case the goods have been forwarded without any regular papers and the centre-station has consequently not been able to give the necessary information by telephone.

e) List of receipts and payments (Appendix V).

This list is made out by the manager for each accountancy day.

The difference between the daily total of receipts and that of payments shows the amount which the manager sends in each day to the centre-station in his receipts-bag, by an appointed train.

The forwarding of goods is done on the same lines as in the case of main line traffic, viz. according to each case : by the shortest route or by the fastest route.

It is not necessary that goods should pass through the accountancy-centre-station. If the regular documents cannot be prepared by the centre-station in time to hand it to the same train carrying the parcels, the latter leave the « sim-

(1) The form reproduced is No. 1 (Counterfoil). Nos. 2 to 4 copies are identical except as regards the headings.

ALSACE-LORRAINE RAILWAYS.

COUNTERFOIL

APPENDIX III.

(1) Single speed. / Agricultural parcel. / Express parcel. / Fast goods train. / Slow goods train.

Consignor ...

Consignee ...

Receiving station ... *Department* ...

Delivery to be made : at station (1) at consignee's door (1) by express (1) (2).

To be forwarded : carriage forward (1) or carriage paid (1) general tariff (1) or special tariff (1).

Disbursements ... *Counting* ...

Cash on delivery ... *Insurance* (delay in delivery) ...

Payment of reimbursement (1):
- to Mr. ... Address : ...
- at, or by station of ..., at address of consignee,
- by Postal Cheque a/c. No ... Bureau at ...
- through a/c. No ... of Clearing House.

Amount to be insured (in words) (2) *with the « Cie Européenne d'Assurances de Marchandises et Bagages »* ...

Marks and numbers of packages.	NUMBER AND NATURE OF PACKAGES.	Gross weight.	Appendices. Remarks.

Handed in ... (date) ... (time) ...
(*Signature of official*), (*Signature of consignor*),

Date stamp.

Amount of carriage.

charged on departure	to be collected on arrival
...	...

(1) Cross out when not needed. — (2) For express parcels only.

Appendix IV.

FRENCH REPUBLIC
ALSACE-LORRAINE RAILWAYS

Operating.

Station :

DELIVERY FORM

declare I have received this day 19

..... . packages . . .

packages ....

sent from ....

I have paid the sum of (in words)

....by way of deposit.

Consignee,

(Reverse side)

Part to be filled in by the deputy.

Number of packages .... Nature of goods .

Weight

Marks of packages ....

Kind of goods (according to labels) . . .

Despatch station ....

Name of consigner (if possible) ....

Address of consignee . .

Reimbursement (according to labels) ....

Date and train from which packages were received ....

FRENCH REPUBLIC

ALSACE-LORRAINE RAILWAYS

ACCOUNTS DEPARTMENT.

LIST OF RECEIPTS & PAYMENTS

Sheet N°.

Station or halt

for the date

Date.	Number.	Origin or destination (or name of payee)	RECEIPTS.							PAYMENTS.				REMARKS – Receipting of disbursements.
			Total received.	Passengers.	Luggage.	Carriage paid.	Supplementary receipts	Carriage forward and cash on delivery.		Total payment.	Disbursements.	Overcharges. Reimbursements.		
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		TOTAL.												

Recapitulation.

Receipts		
Payments		
Difference. . . . . (sum to be paid in).		
Sum paid in . . .		

N° ______

Station / Halt ......

Received the sum of

(Signature)

(Date stamp)

plified-accountancy » station accompanied by a temporary sheet. The simplified-accountancy halt sends the forwarding note to the accountancy-centre-station and the latter, after having prepared the regular documents, sends them under cover by the first train to the destination station.

On arrival at the receiving station there are two procedures :

a) if a parcel is forwarded carriage paid, the receiving station delivers the parcel to the consignee without any difficulty;

b) If a parcel is sent carriage forward, or cash on delivery, or if any outlay is to be collected from consignee, the receiving station, if it has not received regular papers, calculates the amount of carriage plus outlay and value of the goods and collects same, into an open account, plus any expenses. On receipt of the regular papers it closes the account.

The P. O.-Midi Company has introduced a system of simplified accountancy, which is, however, applied only to « annex stations » and not to entire lines. This régime comprises this further particularity : When a forwarding-route, starting from a « simplified-accountancy » station, does not pass through the centre-station, a station situated towards the station through which the traffic runs is appointed as an *annex-centre-station* for assessing and registering such consignments.

It also appears to us of interest to mention the case of the Reading Company, Philadelphia, which has centralised the accountancy of all its stations at the Office of the Auditor of Freight Traffic. The employees at stations only forward way bills, collect freight and pay in to the bank.

The Belgian National Railways Company has also initiated a system of simplified accountancy. The book-keeping, etc. of certain halts where there is only light traffic is mingled with that of the managing station. Halts only have to keep a book of receipts and expenses and a statement of receipts for passenger tickets. These various documents are handed over daily with the takings to the managing station, which draws up the monthly statements.

Management of stations by persons who are not railway officials.

On a certain number of railway systems, especially the French ones, the management of small establishments has been confided to an auxiliary staff or to contractors who have hire contracts with the railway. These supervisors are bound to be present on the passage of trains (goods or passenger) but can go about their business in between the passage of trains. They cannot, however, leave the station premises, in order that they may attend to the wants of clients of their depot.

Railways which hand over the management of small stations or halts to persons who are not railway officials only do so after having made inquiries as to the conduct, previous life and knowledge of such persons, in order to have some guarantee that the service will be properly carried out.

The member Administrations also state that they do not intend employing persons who are not railway officials for duties connected with the safety of trains, such as the working of points or signals, interwals between trains, etc. Nevertheless, the Long Island Railroad and the Pennsylvania Railroad use such persons, in case of need, but they must be recognised beforehand to be fit for such duties. In addition, some Administrations also intend, in certain cases, to have level crossing gates attended to by persons who are not railway officials; but such persons must have

passed a prior medical and practical examination.

Ordering of empty wagons.

The demands for empty wagons by consignors is, in general, done in the same manner as on main lines. The consignor asks for one or more wagons at the departure station, which makes his requirements known to some office entrusted with the distribution of empty rolling stock on the system.

At small stations and halts which are not managed by a railway official the order for wagons is transmitted by the supervisor to the centre-station which in turn does the needful for a wagon to be placed in due time at the disposal of the consignor. Some administrations, in addition, admit the faculty, for the consignor, of ordering wagons direct from the centre-station.

Other systems of simplifying work.

In addition to the régimes of assessment and accountancy described in the previous pages, nearly all the railways have instituted systems of stopping points for trains, which are unguarded, and are either worked by railway staff or by a supervisor not being a railway official.

These stopping points are usually only open to travellers having no luggage to register. A few Administrations, however, also accept luggage to be registered.

Passengers take their places on the trains without any tickets. The issue of tickets and, in case of need, the registration of luggage is done by the guard. Certain railways, however, have the issue of tickets and registration of luggage attended to by the first station following the stopping point, or else by a junction station, or even by the destination station. These two kinds of working can be applied simultaneously (Alsace Lorraine Railways, P. L. M. and the Belgian National Railways Company).

A few member Administrations also have unguarded halts which are open to goods traffic (French Est and Nord Systems, Central Argentine Railway, Reading Company, Pennsylvania Railroad, and the Belgian National Railways Company). The five first named Companies have restricted such goods traffic to complete wagon loads, whilst the Belgian Railways also allow retail traffic at them.

In these cases the consignors have to be present at the station when a train stops, whilst the train personnel accepts and checks the goods. The assessment and accountancy are then done, as a rule, by a neighbouring station.

On arrival, the consignees of the goods are advised by letter or by telephone from the neighbouring station and it is up to them to come to the train and take delivery of their goods.

If the consignee is not present on arrival of the train, the wagon — the doors of which are padlocked beforehand — is left on the siding of the receiving establishment. As to retail parcels the consignee of which is not present on arrival of a train, they are carried on to the terminus of the section.

In both cases it is up to the latter station to re-inform the consignee and invite him to take delivery of the wagon or parcel which awaits him.

Work of the train personnel.

The various member Administrations report few cases where the staff who travel on trains have to assess, collect charges or do accountancy for the issue of tickets, registration of luggage and the acceptance and receiving of goods.

1. The Belgian National Railways Company mentions the case in which the guard collects the transport charges for express parcels not exceeding 15 kgr. (33 lb.) in weight. That is a very

simple method, seeing that the rate is independent of the distance between the forwarding and receiving stations.

2. The French Est and Alsace-Lorraine Systems have put into force a method called « economic working » in which the trains are manned by sedentary station employees instead of guards, etc.

These station employees carry out a mixed service, viz. partly in stations and partly on trains.

This régime is not applied solely on secondary lines but it is used specially on them, and trains thus manned serve in almost all cases establishments worked under the simplified-accountancy régime.

The object of the « economic working » system is to use train men continuously for the time they are on duty, which is not possible in the case of employees specialised in train services on lines carrying light traffic or on which a shuttle service is run. In such cases stops in stations, and notably at terminal stations of runs or branch stations, almost always exceed the duration of the runs carried out by trains.

As an instance, we will describe the method called « economic working » used on the Alsace-Lorraine lines.

Sedentary station staff travelling on trains have the same duties as staff specialised in travelling on trains. They have, in addition, to do the following work, generally carried out by station staff :

1. *Goods trains.* — Carrying out, under the direction of an employee acting as a train guard, shunting duties, working the points, accepting weighing, labelling and sealing of wagons, serving private sidings, and the keeping of documents concerning such services. Cleaning and oiling switches, when the service to be carried out and the duration of stops allows of it.

2. *Passenger trains :* Carrying out, by employees acting as guards, of all operations connected with the issue of tickets and registration of luggage in « simplified-accountancy » establishments. For this purpose, the said employees are supplied with :

— Books of blank (manuscript) tickets ;

— A book of slips for additional charges;

— A book for registration of luggage and numbered gummed slips;

— Destination-labels and route-labels of the blank type for parcels and luggage;

— Tariffs and sundry documents.

During the stops of trains the travelling staff check and complete, when necessary, the papers and labels of parcels or wagons; they make out tickets and luggage forms when supervisors of stations have not been able to do so.

If the locomotive is staffed by two men, the train men may call on the help of the fireman for the handling and putting in place of heavy packages; they inform the driver in advance of any stations or other stopping places where such help will be required.

They pay in any money to the centre-station and point out to the latter, or to the first important station on the run, any mishandling they may not have had time to repair.

Employees carrying out mixed services do duty, in addition, in one, two or even three different stations; they mostly replace staff at meal times and their service is so regulated that they can sleep in their own homes.

The following table gives the number of stations and halts in which the assessment and accountancy services have been simplified :

Administrations.	Number of stations or halts in which the service has been simplified.	Remarks.
Japan	65	...
Central Argentine Railway	9	...
Reading Company	61	...
Long Island Railroad	208	46 of which are unoccupied.
Pennsylvania Railroad	1363	For which 215 zones or centre-stations carry out assessment, accountancy. — 1920 stations are unoccupied.
Belgian National Railways Co.	95	...
French Systems :		
State	440	Introduction of rudimentary accountancy.
Est	3	...
P. L. M.	65	Transformed into supervised stopping points. 9 stopping points are transformed into non-supervised stopping points; 16 stopping points have been created.
P.O.-Midi	202	...
Alsace-Lorraine	92 67	Introduction of : Economic working. Simplified accountancy.

Conclusion.

Each Administration has carried out investigations with a view to reducing its working expenses on its lines carrying only light traffic by having recourse to economic working methods adapted to the service to be carried out.

The various measures taken can be summarised as follows :

1. Use of short light trains, notably by reducing the number of classes in coaches and by using a compartment as a guard's van; driving of the locomotive, in certain cases, by a single man.

Substitution of rail motor cars for little-used passenger steam trains, sometimes with increased number of runs to improve the service on the lines and increase or protect traffic often sought for by road competitors, the profit of the change-over depending both on the amount and frequency of passenger-traffic peaks and the conditions under which goods traffic can be carried out.

2. Suppression of keepers at certain level crossings where road traffic is only light.

Simplification of signalling, consisting of the elimination of signals and particularly of distant signals.

Reduction of the number of stations in which safety precautions requiring the presence of operating department staff are carried out.

3. Simplification of station accountancy work at stations and halts where traffic is light by removing such work to a more important or centre-station, enabling regular railway personnel to be replaced by auxiliary staff or staff contracted for in stations and halts which are not traffic depots.

4. Transformation of stations and halts occupied by a staff into non-occupied establishments; the forwarding and delivery of goods is done, when such stations are open to goods traffic, as in the case of private sidings.

5. Use of sedentary station-staff to travel on trains during parts of the day.

[656. 212.5 & 656. 225]

INTERNATIONAL RAILWAY CONGRESS ASSOCIATION

13th SESSION (PARIS, 1937).

QUESTION VIII.

Application of rational organisation (planning) to the transport of goods,

especially in connection with :

1. the functions and internal working of shunting yards;
2. the provision of inter-yard connections;
3. the estimation of the probable traffic to be dealt with, and the provision of the trains required;
4. the information to be given to the consignees;
5. the acceleration of the turn-round of empty stock;
6. the use of containers and rail-road wagons.

REPORT

(Belgium and Colony, Luxemburg, Netherlands and Colonies, France and Colonies, Spain, Portugal and Colonies, Italy and Egypt),

by J. COLLE,

Ingénieur principal au Service de l'Exploitation, Belgian National Railways Company.

SUMMARY.

As regards goods traffic, the railways have been compelled, by the competition from other forms of transport and by their present financial difficulties, to try to develop new operating methods.

By investigating Question VIII in the light of the replies from the railways covered by this report, we have been able to call attention to scientific methods of organisation by which the costs can be reduced and the traffic worked more quickly and regularly, with greater facility and convenience to the user.

* * *

Introduction.

Scientific organisation of work by planning methods has become more and more necessary in recent years in all branches of industry.

A point to be emphasised is the way such methods have been adapted to railway working, and in particular to the goods traffic.

* * *

CHAPTER I.

Functions and internal working of shunting yards.

The shunting yard can be considered as admitting of the application of scientific management, or planning.

1. — Splitting up trains scientifically.

The organisation of the work of splitting up the trains is based on the traffic being formed in lots.

The function of the shunting yards is to receive and make up non-stop, through, and pick-up goods trains. These yards therefore receive and make up lots of wagons.

Each lot consists of wagons which will run over the same route, to the same destination, the same part of the receiving station or the same area served by a particular receiving shunting yard. As a result of this grouping of the wagons it is usually quite easy to ascertain the destination siding in the yard either from a simple table or from the labels on the wagons.

* * *

The work to be done in splitting up the trains can be subdivided into two parts : preparatory work getting ready to shunt, and the actual shunting.

The preparatory work includes :

Checking and if need be marking the wagons;

Examining the stock;

Drawing up the shunting list;

Getting ready to uncouple the cuts;

Records.

When the organisation adopted does not provide harmonographs of the operations to be carried out, it is based on the local equipment and methods so as to carry out the different operations in the shortest time under the supervision of staff whose management is controlled by the output obtained.

Checking and *marking* the wagons are not indispensable operations. For example, on the French Est Railway, the guard on arrival hands in to the yard office a statement giving the gross weight and if required the braked weight for each wagon in its train order and the lots of which the train is formed. This information in conjunction with a special labelling makes it unnecessary for the shunting yard staff to go down the train and mark off the wagons, and is all that is needed for getting out the shunting list.

On the P.O.-Midi Railways, only the destinations of the wagons are shown in their order in the train on the guard's statement, which is completed in the yard office by adding the reception

siding numbers, or alternatively the train is gone over and the wagons marked in chalk with the reception siding numbers, which are also inserted in the statement.

The technical *examination* of the wagons is carried out so that damaged wagons can be shunted into the cripple sidings for repairs. By this means shunting out such wagons from the trains when ready to depart is avoided and urgent or particularly wanted wagons are not delayed.

The continuous brake is tested by means of the compressed air installation whilst the train is being examined.

The *shunting list* is in general use. It has various forms, the simplest giving in their order in the train the cuts to be passed over the hump, the number of the reception siding, and the number of wagons in each cut.

This list is handed to the yard master and the leading shunter who uses it to divide the braking amongst the shunters.

Preparatory work of uncoupling the train includes dealing with the couplings (unscrewing the coupling, uncoupling the air brake train pipes, releasing the brakes) and unhooking the safety chains when fitted. The men do this work in accordance with the marks on the wagons or the indications on the labels.

The method used on the French State Railways may be noted : in the modernised stations, in which the reception and shunting sidings are arranged in succession every wagon is uncoupled so as to do away with the man who separates the cuts at the hump.

The only practical drawback to this method is that if a derailment occurs whilst shunting a rake, in the points area at the head of the group of sidings, so as to interfere with the first point after the hump, all the roads are blocked. This sort of accident is very rare and the French State Railways have never found it caused any serious difficulty. Obviously visual and audible communication with the driver has to be provided when this method is adopted, so that he can stop practically instantaneously.

The forms filled in during shunting vary from one railway to another. They include : checking the consignment notes and their stampings, classifying the consignment notes by destination, preparing the list of trains before departure, and noting other information in connection with the wagon accounts, locating delayed wagons, etc...

* * *

The organisation of the *shunting work itself* has to include allocating a siding for each incoming train, deciding the time required by the shunting engines for each operation, distributing the brakesmen (shunters) according to the cuts of wagons in each train, and when necessary fixing for each cut the braking lengths of the first and second skid shoes.

* * *

The question of *braking wagons* during shunting and organising the work scientifically has been investigated many times.

As is known, in gravity shunting the wagons are pushed over the top of a hump and then allowed to run down the gradient into the siding for which they are intended.

The shunting should be done in such a way that the wagons come together without violent shock, to avoid damaging them or their loads.

It must be done in such a way as to prevent the wagons overtaking one another in the points area.

The gradient from the top of the hump to the sidings must be designed to meet these conditions; it involves having to brake the wagons.

The braking consists of one or two phases :

1. first braking to separate the wagons so as to prevent them overtaking one another in the points area;

2. second braking at the end of the run to ensure the wagons stopping where required in the siding.

With slipper brakes, and therefore without any mechanical track brake and very low labour costs, the wagons after a little experience can be braked sufficiently accurately to keep down damage and at the same time allow 5 to 6 wagons to be passed over the hump every minute.

Two problems have to be considered before introducing this organisation :

1. To ascertain the wagons or groups of wagons for which the single braking at the end of the run would be insufficient;

2. To make sure that the speed of such wagons or groups of wagons can be sufficiently reduced by a preliminary braking.

These problems can be solved mathematically by systematically ascertaining the braking lengths in the sidings and also on the lines leading to the sidings when necessary to stop the wagons at the beginning of the sidings, in terms of the ordinary brake constants and wagon resistances. When the resistance of each type of wagon under different loads at low speed is known the braking length required can be found.

The computation of this resistance is rather hazardous, so that it is better to ascertain the probable braking distances by experiment and base the lengths on the ratio of the weight of the first pair of wheels of each cut to the total weight of the cut.

The Belgian National Railways Company has successfully used this method since the 1931 summer.

The wagons are braked by means of slipper brakes and turn-out rails. A table gives the first and second braking distances according to the usual braking constants, the classes of wagons empty or loaded, as well as the different reception sidings of the group of sidings in question.

The employee responsible for preparing the shunting list records in their order the different cuts, the reception siding, the number of wagons, the total weight, and the weight and number of pairs of wheels of the leading wagon.

The assistant yard master completes the list by adding the braking percentage and the probable braking length for each cut, from the table described above.

If the work of the brakesmen is properly combined, one or other of the men can be used temporarily for other work, such as accompanying wagons which have to be shunted with care or to work the hand-brake of a large cut, without over-working the other men.

In such circumstances a braking list is prepared from the shunting list for each brakesman, showing the order and number of each cut to be braked, the reception road, the number of wagons in the cut and the braking distance.

Pieces of wood painted red are placed 10 m. (11 yards) apart between the rails, showing the accumulated distance from the point of entry to enable the brakesman to judge the braking distance.

When shunting at the rate of 5 wagons a minute a brakesman in charge of the second-line brakes can deal with 6 sidings of a group of 40, whereas a brakesman at the first-line brakes is required per two turn-out rails. When shunting at a slow rate such as 2 wagons per minute a brakesman at the second line of brakes can deal with nine sidings.

The French Nord Railway has applied the same principles with improved results compared with those obtained

when the shunt braking is left to the judgment of the men. This Company reports that in the case of long leading-in roads resulting in great differences between the speed of good and bad-running wagons, the braking areas were too great to give any useful indication to the brakesmen. This Company was consequently led to base the braking length on the speed of the cuts.

The first trial of this method was made in Dunkirk (Dunes) shunting yard.

The speed is measured by means of a chronograph over a length far enough from the point from which the cut is left to itself for its speed to be influenced by its running conditions and the weather, and sufficiently in front of the braking area for there to be time to calculate the braking distance and transmit it to the brakesman concerned, by megaphone.

As satisfactory results were obtained, the method will be introduced into other shunting yards.

No case of scientific organisation of braking has been reported when automatic brakes are in use.

* * *

Harmonograph of the scientific organisation of train shunting.

When the organisation is based on harmonographs the indications of which have to be obeyed as far as possible, the different operations considered above have to be investigated in detail in order to arrive at the best and quickest way of carrying them out. A large number of timings have to be made in order to ascertain the average time needed.

Having defined all the operations to be carried out, the next thing is to group them by classes. The labour required is then allocated so as to equalise the time taken to do them in accordance with the rate of shunting, i.e. the time between two successive cuts when they leave the hump. This interval determines the output from a shunting yard and is the minimum possible with the shunting locomotives available.

On the other hand, this scientific organisation implies continuity of work during the various shifts of the day.

This method therefore fits in perfectly when the trains are held in the incoming reception roads so as to deal with them at a higher rate during part of the day; it also meets the case of a slower rate of shunting spread over the whole day without interruption, with smaller gangs working to full capacity.

The French Nord and Belgian National Railways are the only Administrations consulted using harmonographs of the operations involved in shunting trains.

Details of the Belgian method are given in the article published in the March 1932 number (English edition) of the *Bulletin of the Railway Congress.*

The French Nord uses harmonographs based on the principles given above. So that the two methods of working can be compared we reproduce, figure 1, part of such a harmonograph for shunting a train at a 25-minute rate.

* * *

In order to make the harmonograph agree as closely as possible with actual conditions, the French Nord has drawn up for each yard in which planning has been introduced three sets of harmonographs, one for good, one for bad, and the third for very bad weather, so as to take atmospheric conditions into account.

The graph is checked by a controller in telephonic communication with the sidings. He draws the graph of what actually takes place, showing the time of arrival, the reception road, and the time the train was shunted, the other

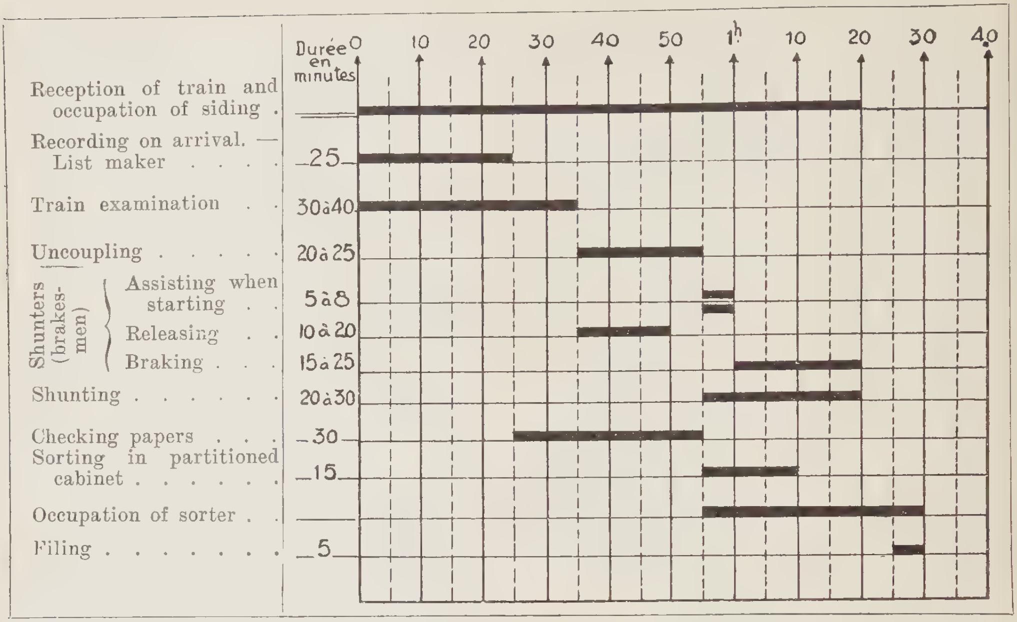


Fig. 1.

Note : Durée en minutes = time spent, in minutes.

operations, which are only intermediate stages, not being checked..

The Belgian Railways have the same check; it is done by the assistant yard master and includes the secondary operations.

The French Nord has come to the same conclusions as the Belgian Railways, namely that experience shows that the harmonograph can be followed very closely, and there is no need to get out a special harmonograph each day.

The yard master, on receiving a special train prepares a special list for it showing the reception road and the way the various operations are to be carried out.

The French State and Est Railways have not drawn up harmonographs although the organisation in force in their shunting yards may be said to base the general guiding rules on the sequence of the different operations.

Thus, the theoretical graph of the occupation of the reception sidings does fix the way the train was handled on arrival. An occupation graph for the departure sidings is also got out; a graph of the actual occupation is drawn up each day.

The work done by the shunting engine and the way it was used is checked by means of an occupation graph.

* * *

As a rule only one shunting engine is used in any one fan of sidings. The Belgian National Railways Company reports that when the rate has to be less than 22 minutes per train, two engines are used and a 60-wagon train can then be shunted every 17 minutes.

Some other railways only use a second engine when more than 3 000 wagons have to be shunted in the 24 hours.

The time the shunting engine takes to

get from the hump to the rear of the next train is 4 to 5 minutes, and as long to push the rake to the top of the hump when the groups of sidings are arranged in succession.

When the reception sidings are alongside the shunting sidings, 15 to 18 minutes are needed to get the train to the hump.

We received little precise data on the shunting speed.

The normal speed on the French State Railways is 6 to 7 wagons per minute, and 10 under the most favourable conditions. In the best equipped yards of the French State Railways, the maximum speed is 9 to 10 wagons and the average 6 wagons per minute.

The normal speed of shunting really depends on the yard equipment; it represents the limit beyond which probable mistakes would cause more time to be lost than could be saved by faster working.

So as to ensure a high enough shunting speed, the shunting locomotives are being fitted with a low-speed indicator as an experiment.

On the Belgian National Railways, in shunting yards with the groups of sidings arranged in succession, the normal speed is 5 to 6 wagons a minute, and 2 per minute when « slow working » is in force.

***

Organisation of pointsmen's work.
Points operation from one or several ground frames.

Each pointsman has a shunting list which he follows in preparing the routes of the different cuts of wagons coming off the hump, and he checks his work by watching the wagons as they come down.

In principle, however, the point levers are all concentrated in one frame.

Points operation from an automatic, semi-automatic (electric, or mechanical) box.

In this case too the pointsman is given a shunting list so as to know what to do. Cuts of wagons, readily recognised by their load or the class of wagon, are specially marked on the list for his guidance.

In other cases, the shunter at the hump is able to switch on lights showing illuminated numbers representing the number of the shunting sidings, and thereby confirms or annuls the indication shown on the list.

The Belgian National Railways have used since 1931 a cheaper and equally precise method in the semi-automatic shunting boxes. After the routes have been stored up from it in the automatic selector, the shunting list is used by the pointsman using the hand-operated distant-controlled points. In order to do this, the shunting list which is drawn up on a roll of squared paper, is inserted into a holder in which it is automatically unrolled as the wagons run down the hump. As each cut passes over the insulated rail at the beginning of the down gradient the paper moves forward one line the indications of which are brought opposite a finger in the middle of the window. The window is wide enough for ten lines to be visible.

The pointsman can therefore prepare the routes to be followed, whilst checking the accuracy of those already set, by supervising the wagons out in the sidings, or in the case of fog by switching out the light indicator on the control table.

All such operations are not carried to standard schedules (progress planning).

***

2. — Scientific organisation of train marshalling.

Train marshalling on scientific lines is based on knowing the number and

tonnage of the wagons in each shunting siding.

The extent the sidings are occupied is found in many ways, the most usual being by classifying the papers of the wagons shunted in different sections of a partitioned cabinet corresponding to the different shunting sidings. The number of wagons and the load in the corresponding siding is easily obtained from the papers in each section.

Another method is to transfer from the shunting list the wagons shunted off each train onto a special sheet with as many columns as there are shunting sidings, entering the number of wagons and their tonnage for each siding.

When a train leaves, the number of wagons and the tonnage dispatched is subtracted from the column representing the siding concerned. The balance at any moment gives the position in the yard, on which the yard master bases the work to be done and orders any additional trains needed or cancels those not needed.

When this information is known, marshalling the trains involves the following operations :

Through trains. — These trains being formed of wagons for a single destination (or a collection of unsorted lots) are made up directly as the shunting proceeds, with possibly certain slight changes in connection with the automatic braking and a brake van is attached.

Trains for several destinations : stopping or local trains. — These trains convey batches of wagons which will be detached at various stations en route.

Two working methods are in use :

The old method is in general use in the stations on the railways consulted. The marshalling is done at the head of the group of sidings away from the main hump, using the leads of the sidings for sorting « geographically » the wagons for a particular train. These wagons were previously collected in a siding set aside for this purpose.

Having divided up the wagons by destination on the leads of the sidings they are then taken back in the station order required.

In this case the organisation is limited to estimating the time required for each operation according to the number and tonnage of the wagons, and to arranging the shunting engine workings in such a way that the train is marshalled opportunely.

On the French Nord, Est and State Railways, when a number of semi-through or local goods trains are booked to leave about the same time, such trains are marshalled simultaneously. Instead of setting aside one siding on which all wagons of a train for a number of destinations are collected, the wagons are suitably distributed over a number of sidings. Having done so the different trains can be marshalled, in two operations, into the desired order simultaneously.

This method is based on the following principles :

1. With a given number of sidings, wagons can be classified methodically in two operations for a number of destinations equal to or less than the square of the number of sidings used.

2. However varied the destinations and the positions of the wagons in the rake to be shunted, some of them are as a rule more or less in proper order though this may not be apparent, a fact which should be made use of.

3. It is quite unnecessary to know the actual composition of the train or of the rake bringing in the last wagons before starting to marshall the trains. In accordance with this theory, the first operation is carried out as the wagons arrive; the second operation is only taken in hand when all the wagons for the different trains have undergone the first operation.

The time allowed for each individual operation (shunting and marshalling) can be based accurately enough on timings. It is therefore possible to estimate beforehand the time to be allotted for marshalling a train with multiple classifications.

Planning in this case consists in fixing once for all the purposes for which each siding is to be used, the order the wagons are to be shunted in, and the times at which these operations are to be completed for the trains to be ready in time.

The work is followed all the time on a graph kept by the yard controller.

The railways marshalling their trains on these lines unanimously agree that the shunting is appreciably reduced.

* * *

In view of the falling off in traffic on all the railways it will be of interest, in closing this statement on shunting and marshalling trains, to review the methods introduced to cut down expenditure when the traffic is too small to keep a shunting yard fully and continuously employed.

The method generally found to be the most economical is to work two shifts instead of three. The drawback to this method is the delay in transit times of wagons received when the yard is closed. This drawback can be remedied to some extent by adapting the timetables to suit.

Another method referred to in our review of the principles of planned shunting is the « slowed down », which consists in reducing the rate of shunting so as to reduce the number of men needed to get the trains ready for shunting and also for steadying the wagons. This method has the much sought after advantage of not delaying the traffic. It has also been found possible to close down shunting yards by modifying the « groups » or « lots » of wagons on trains, as the traffic had fallen off.

* * *

CHAPTER II.

Provision of inter-yard connections.

1. — Organisation of the booked train service.

Trains.

The shunting yards are linked up by through trains which only stop for water, to change engines, or when being overtaken by passenger trains.

In certain cases the connecting trains stop at one or more of the important stations or at junctions where wagon lots are attached or detached so as to adapt the engine power more closely to the gradient conditions or to improve the train working when there is insufficient through traffic.

Outlying shunting yards on some railways are served by trains which must not be cancelled nor made optional nor run out of the regular working; they are worked regardless of load.

Composition.

The composition of the trains depends on the gradients of the lines and the power of the locomotives used; it therefore varies from one railway to another.

The present tendency is, it is interesting to note, to work heavier trains made up of 65 to 80 vehicles. The French State Railways report that the latter figure is not the absolute maximum in certain particular cases.

Speed.

A move towards higher speeds of the through heavy goods trains between shunting yards is noted. The maximum speeds are : French Nord, 80 km. (50 miles); Paris-Lyons-Mediterranean, 70 km. (43.5 miles); P.O.-Midi and Belgian National Railways, 65 km. (40.4

miles); and the French Est, 60 km. (37.3 miles) an hour.

These maximum speeds are resorted to in certain cases only, as the operating costs are reduced considerably when heavy trains are worked.

Number of trains.

The number of trains between shunting yards is based on the average daily loads to be worked. This average is based on the previous year or half year's figures on different railways.

Route.

These trains are run over the shortest, the cheapest, easiest, or the most convenient route according as economy, short transit periods, regular and steady flow of sufficient traffic, reduction in the number of stops.

Timetables.

These are based on getting the wagons forming the bulk of the traffic through as quickly as possible taking into account the time they reach the shunting yard and the period the yard is open, when it is not worked continuously.

When on the other hand a particular train timing has to be worked to, the work in the shunting yard is organised to suit, so as to get the wagons away again as soon as possible.

The goods train times remain, of course, subordinated to those of passenger and express goods trains.

To make the best use of the train crews on the return working within the regulations on the hours of duty, the working selected for one direction fixes fairly closely the return working for the same crews and engines.

As wagons arriving in a shunting yard must go forward the same day or early the next day, there should be a regular day service between the shunting yards. If the traffic is heavy enough to justify several such workings, they should in principle be run at more or less regular intervals.

Planning.

This consists in the train working diagram, and is controlled on most railways by a special organisation, generally known as the « dispatching system » or « train control ».

This method has been described so often that there is no need to do so again. All railways unanimously agree on the effectiveness of this method of controlling the running of booked trains, and on the more regular working and large savings obtained from it.

There are several ways this system can be put into use :

1. The train workings are controlled by area controllers, usually at the different area heardquarters, working in collaboration as regards trains running through several areas;

2. The same organisation with a central information office which also coordinates the activities of the area controls;

3. A single central control office over the whole railway system, covering the duties of the area and headquarters controls. This method has the advantage of being under one head.

So far as we know, only the first two methods are in use.

* * *

2. — **Optional or special-train service.**

The number of wagons the booked trains can work away is based on the average number worked daily during the previous period selected when getting out the train services.

It may be too small, i. e. when the booked trains have left loaded to capacity, wagons for one or other of the destinations served by them may be left in the shunting sidings.

The question then arises how to for-

ward these wagons in the most practical and economical way.

Generally speaking, the Railways consulted work these additional wagons forward on optional trains at times given in the working timetables and shown on the train diagrams. Special trains or trains to timings made out just before starting are quite exceptional. Such special trains are in principle regular or optional trains, the departure times of which have been shifted forward or back; they are only run when a shunting yard has to be cleared and there are no optional workings.

The Belgian National Railways provide for optional timings, but special trains are mostly used at timings fixed as required. These trains are controlled by the dispatching system now in use on all the main lines.

Optional trains are nonetheless the best arrangement as all unknown factors as regards the running are avoided. The optional train times having been got out beforehand, the train working is quicker and the locomotives can be used to better advantage.

Two cases arise when forwarding superabundant traffic :

A. — The number of excess wagons is too small to justify a special train; the wagons are then held for the following trains the same day or next day;

B. — The excess is relatively large.

As a rule the yard master is not allowed to decide when additional trains are to be worked.

The Railways consulted report that they lay down the number of wagons or the load justifying an additional train.

On the French P.O.-Midi, Nord, and State Railways, a full load or maximum number of wagons is specified; on the Paris-Lyons-Mediterranean 90 % of the booked load, or 65, 70, 75 or 80 wagons according to the line to be used.

The Belgian Railways require 80 % of the load in tons or axles.

The French Est and Nord-Belge reduce these figures to 75 %, whilst the Netherlands Railways require at least 20 wagons.

These regulations are only in force when fresh motive power has to be ordered; engines running light for any reason are always allowed to take a load without any restriction.

Before resorting to an optional train between two shunting yards some Railways recommend that for the sake of economy the wagons be worked by any stopping goods trains running in the desired direction not fully loaded in spite of any delay that may result, provided the wagons arrive at destination within the legal transit times.

Another method consists in using, whenever possible, an assisting engine to get the excess wagons away.

Organisation of the method of ordering optional and special trains.

There are tendencies which may usefully be considered, and the conclusions used to organise this service on scientific lines.

Formerly all Railways followed more or less the same method : each shunting yard decided on its own responsibility to run a special as soon as the number of wagons for a given destination exceeded the capacity of the booked trains.

The yard, before ordering the train, took into consideration its own excess wagons, the wagons to be picked up en route, and the wagons it had been advised were coming to it. Each yard, therefore, was run to suit itself and use any locomotives and train staff it might possess to meet its own needs.

With this method, the locomotives could not be used with a sufficiently general view to prevent lost time. There was no co-ordination in using the capacity of the trains run and in the event of a sudden general rush of traffic it

was difficult to give priority to the most urgent trains.

These defects resulted in the Railways setting up special offices to deal with all requests for additional trains. As these offices know the position of all trains in the area under them at all times, they are in a better position to make decisions, select timings for the optional or special trains, see that full use is made of the locomotives in service before turning out additional engines and men, decide the priority of trains according to the position of the shunting yards, and if need be cancel locomotive turns within the limits of the regulations in force. These offices alone are authorised to work optional or special trains and consequently have to issue all the necessary instructions to the yards and locomotive depots under their control.

On some railways these offices are located at divisional (area) headquarters and work in full collaboration with the shunting yard controllers and the dispatchers. On other railways the dispatchers do this work and follow it up.

The organisation then specifies two or more times during the day when the yards must send in their demands for special trains. The decisions made depend on a joint examination of the workings and the engine power available, by the locomotive running and operating officers.

The decisions are transmitted to the yards concerned, and are confirmed by being recorded on special lists. They form the basis of the organisation which controls the way the orders given are carried out, and the timings worked to; the locomotives in particular are watched the whole time they are out of shed. Any delay is enquired into at once by the dispatcher. Any failure calls for a new decision in order that the planned organisation may be worked to.

The economical advantages of these methods are admitted everywhere.

The Belgian National Ry. Co.'s organisation provides for regional dispatchers as well as a chief dispatcher at headquarters. The chief dispatcher receives from the regional dispatchers all requests for additional, optional or special trains and records them on a summarised statement which also records the booked timings, and the times the locomotives were ordered out both at the starting point and at the stations where the locomotives are changed. He is kept advised how the arrangements made are working and with the help of the locomotive running department intervenes when necessary to see the instructions are carried out, as for example by coordinating the use made of the locomotives in the districts under the different regional dispatchers.

This organisation has given good results, especially in speeding up train movements and adapting the spare engines to the needs of the service, a difficult matter, particularly in cases of sudden rushes of transit traffic or traffic from and to harbour stations.

The following additional information completes our statement on the organisation of optional or special-train services :

The decision to run an optional or special train is made as long as possible before the departure time. The decision is based on the situation in the shunting yards and on the loads expected.

On the P.O.-Midi System, as a rule requests for special trains are made twice every twenty-four hours; on the other Railways as required, but early enough for the locomotives to be ordered and supplied. The minimum period varies from one railway to another between 3 to 5 hours, and usually is 4 hours when the locomotive depot is near the departure station.

When the organisation of the service does not allow the train to be worked right through, the locomotives at the changing points are ordered by either

the controller, the dispatcher, or the changing station at the same time as the departure station asks for a locomotive. If no engine is available at the changing station, steps are taken to send a locomotive to it.

To sum up, steps are taken to work to the timing selected and the time at the locomotive changing station is limited to that required to change engines.

The ratio of additionnal to booked trains varies from 7 to 15 % on the French and Belgian Railways, and up to about 23 % on the Netherlands Railways.

There is no fixed rule as regards making optional into booked trains; it depends on the traffic continuing to be offered, but the optional trains may be run as booked trains as often as every other day.

The Belgian National Railways make an optional working into a booked working when the load each day reaches 60 % of the available loading capacity and the increase in traffic is expected to last at least ten days.

One method of checking the adequacy of the train service is to ascertain the wagons which have been in the shunting yards more than 24 hours. The documents relative to these wagons are marked in some distinctive way so as to attract the attention of the other stations en route.

Besides this control the Belgian National Railways have an index card for each wagon which is not worked through in the legal transit time. A check is made to ascertain the route it travelled and whether it was by the trains normally prescribed in the working, and the cause of any delay is investigated. A summary is prepared each week and is used by the Management to correct the weak points in the organisation and faults in carrying out the work.

* * *

CHAPTER III.

Estimation of the probable traffic and provision of the trains required.

An advance knowledge of goods traffic fluctuations would facilitate the yard working and the train service by removing the disturbance caused by unexpected rushes of traffic.

The efforts made in this direction deserve attention.

A. — Long-deferred previsions.

1. *Seasonal traffic.*

Daily traffic statistics usually give sufficient information of the seasonal traffic compared with the changes in such traffic during preceding years.

This applies in particular to heavy beet, linseed, early vegetables, fish, household coal, etc. traffics.

The statistics of the preceding year may have to be adjusted to take into account the harvest, trade demands, changes in values, etc., etc. The adjusted figures are accurate enough to give an idea of the additional trains and yard facilities needed to prevent the regularity of the working being upset by the unexpected traffic demands.

2. *Bulk traffic from collieries and the heavy industries.*

On several Railways, ore, coke, and coal in train loads or in large rakes of wagons have to be worked to a monthly programme, to benefit by the reduced rates. This organisation has made it possible to settle in advance the dates the additional trains will be run and the days they can be cancelled.

B. — Short-period previsions.

1. *Complete train-load traffic.*

As in the case of the bulk traffic mentioned above, other reduced rates are in force which are granted subject to the

consignor submitting a weekly programme to enable the necessary trains to be arranged.

2. *Import traffic.*

The methods to be used to clear this traffic can be determined from the information — probable arrival time of the boats, their tonnage, and the principal destinations of the goods to be landed — received from the shipping companies, and the requests for empty wagons received the previous day from the consignors.

The French State Railways give as an example the organisation in force at the ports of Rouen and Havre. Each afternoon the yards report to the controller responsible the tonnage and destination of the main lots of wagons loaded during the day. The controller draws up the programme for removing them and issues the necessary instructions. The locomotive running department then decides the number of engines and sets of men needed to work optional trains during the night and next day.

3. *Export traffic.*

The Belgian Railways, early in 1936, introduced an organisation intended to keep the operating department informed as to amount of export traffic via Antwerp Harbour.

This organisation, known as « Industrial Dispatching » has to fix at the end of each week, in collaboration with the consignors, the volume and nature of the consignments to be dealt with each day of the following week.

Each day the same consignors give the regional dispatchers particulars of the tonnage, number of wagons, and loading quay of the goods to be loaded during the evening. On receipt of this information the train to be used can be selected and the yards concerned notified. All this information is collected at the central dispatching office which plans the working of it. This office watches the way the work is carried out during the night, its duties being only finished the next morning on being advised that the whole of the goods given notice of the previous day have arrived at the main quays or group of sidings serving the inner quays.

The first part of this organisation is not yet giving the expected results, owing to the consignors not knowing their export programme sufficiently closely a week ahead. The second part is working well, as except under unforeseen circumstances consignments are placed on the quays by 8 a. m. on the day after that of dispatch.

4. *Inter-railway traffic.*

Our enquiry reveals that there is no agreement between railways as to advising each other of a rush of traffic with which the regular trains cannot deal. The Belgian and Alsace-Lorraine railways are making an experiment on these lines. The Belgian marshalling yard at Stockem is in telephonic communication with the Luxemburg Office and each advises the other of any appreciable variation in the volume of traffic, so that the number of trains to be exchanged may be increased or decreased in consequence. The results have been satisfactory, especially in the case of goods carried by the additional trains, which are forwarded more quickly.

5. *General traffic. — Preliminary advices to shunting yards.*

Knowing the amount of incoming traffic from the reported composition of the trains about to leave a yard or on the line from another shunting yard, the organisation of the work, the demands for or release of plant, and the orders for optional and special trains can be taken in hand sufficiently early to give the running department time to provide the motive power and so avoid abnormal turns of duty and quicken the turn-round of the stock.

The telephone advice between shunting yards and stations on some railways gives for each train the number of loaded wagons, the tonnage of each lot, and the number of empty wagons by classes.

On other railways this advice is given more simply and quickly through the dispatcher or train controller.

This organisation ensures that each shunting yard always knows eight hours ahead the traffic to be dealt with and forwarded; it effects appreciable economies and makes the shunting yards' work much less hazardous.

C. — Information to be drawn from the consignors' requests for empty wagons.

The railways consulted have no organisation for systematically collecting data from the demands for empty wagons.

The wagon control office keeps the operating department advised as to marked changes in the demands for wagons; the stations concerned are kept informed by the local dispatcher, and besides enquiring when the wagons will be loaded make arrangements for working the additional loads forward.

The consignors, except on request, do not state the latest time the empty stock demanded will be loaded. These consignors are nonetheless advised by their stations of the hour the loading must be completed to ensure the wagons being worked away by the booked trains.

* * *

CHAPTER IV.

Information to be given to consignees.

I. — Arrival advice note.

a) Ordinary goods.

In almost all cases the rates in force require the carrier to advise the customers when goods, and in particular full wagon loads arrive for them.

The Spanish Railways are content with posting up at a place known by the public, a list of the wagons received with the names of the consignees.

The French Railways as a rule advise consignees by post, debiting them with the postage.

The Railways use all other faster methods, such as express letter, telephone and telegraph, especially when it means liberating the stock 24 hours sooner or charging demurrage costs. The consignee only has to bear the cost of postage unless he specially requests the advice be transmitted by some more expensive method than a postal letter.

The day and hour the advice note is received fixes the beginning of the period allowed for unloading.

On the Belgian Systems, notice of the arrival must be given by the quickest way available, telephone, special messenger, post, express or telegram at the choice of the railway.

b) Livestock, commodities and perishable goods.

On certain Railways, such as the Paris-Lyons-Mediterranean, P.O.-Midi, and French State, no special steps are taken. On others, such as the French Est, the name and address of the consignee of wagons of livestock are telegraphed to the destination station which then advises the consignee.

On the French Nord, if the cattle wagons are not met, the animals are offloaded and impounded at the cost and risk of the customer.

In many cases men travel with the cattle trucks and no advice is sent to the consignee.

The Netherlands Railways only advise the consignee when the wagon is not taken delivery of within 4 hours of its arrival.

On the Belgian Railways, when the

consignee is not present to meet the wagon on arrival, he is advised at once by telephone, express letter or telegram at his expense.

c) Period within which the advice note is send.

As a rule, the advice note is sent as soon as the goods are ready to be offloaded, or it is known when they will be.

Other formulae are : advice sent by post within 4 hours of the arrival of the wagon, the period between 10 p. m. and 8 a. m. not included; 1 hour after the wagon is received, and in the case of wagons arriving during the night, the first thing in the morning.

d) Filling in the advice note.

The advice note is filled in by either the receiving station or the dispatching station; as the latter method is quicker it is replacing the other, formerly resorted to as a rule.

Present-day commercial methods require the consignor to notify the consignee the date the wagons left; but this information is not sufficient to dispense the carrier from advising the consignee. The consignee, in the absence of goods-train timetables, cannot ascertain the arrival time from the departure time, besides which the wagons do not always follow the quickest route, especially if the booked trains are overloaded.

II. — Goods-train timetables.

None of the Railways consulted issue goods-train timetables for public use, but most of them collaborate in publishing the international goods timetable sold to interested customers.

The French State Railways publish, as an appendix to the passenger-train timetables, the times of the express and ordinary goods trains together with the regulations as regards loads accepted or refused, delivery period, etc.

The Belgian Railways issue without charge timetables of trains conveying livestock, beer and mineral waters.

The only idea a consignee can form as to the probable date of the arrival of a wagon sent off at a known date is based on the legal transit time.

Goods-train timetables cannot be used much owing to the differences in the actual journey times resulting from the cancellation of little used booked trains, the priority given to registered wagons, and excess loads for booked trains, etc.

In certain cases the date of arrival is nonetheless given in advance. Thus the French State Railways, in order to meet competition, give a fast and absolutely reliable service in the case of regular currents of traffic by special routing with few stops, using certain fixed trains.

Other French Systems are doing the same, and this has led to the issue of a booklet giving the special routes reserved for certain consignors, for certain goods.

The French State Railways guarantee delivery at a given date and in a shorter time than the legal transit time on payment of a supplementary charge of 5 % on one of the scales of rates in force.

In 1935 the French Nord set up, in the case of traffic on its own lines, an organisation known as « Prévisions d'acheminement pour certains wagons » (Anticipated routing for certain wagons).

This organisation applies to all goods which by their nature have to be worked forward quickly, or at least regularly, but not to bulky materials the working of which can be changed or extended within the times allowed for goods conveyed by ordinary goods train.

The object of the organisation is :

1. To enable the stations forwarding a loaded wagon to give the consignor information as to its date and time of arrival;

2. To permit the receiving station to

give the same information to the consignee;

3. To fix the various stations affected as to the routing of the wagon and make it easy to check the way the wagons coming under this organisation were worked through.

This innovation was welcomed by the railways' customers. Between the 1st August 1935 and the 1st March 1936, 121 500 wagons were routed this way, and there were only 1.4 % failures.

III. — Preliminary advice or arrival.

By preliminary advice of arrival is meant the information given by a station to a consignee of the probable date of arrival of a wagon forwarded and the time it will be placed for clearance. Whilst our enquiries show that many railways, in particular the French Systems, forward the documents by the quickest way from the loading to the receiving station, the Netherlands Railways are the only ones at the same time advising the consignee in certain cases of the arrival of the wagon.

The sole object in forwarding the papers in this way is to enable the accounts to be completed as soon as possible after the goods are dispatched. However, this method also facilitates making out the preliminary advice note giving the correct particulars (customer's name, wagon number and weight, kind of goods, rate, etc.) of the consignment.

As a rule the preliminary advice note is made out by the receiving stations as soon as they receive from the previous stopping station, the notice giving the wagons to be received by the first trains to be dispatched.

In principle such advice is only given :

1. In the case of special goods (cattle, unusual loads, etc.) for which the receiving station has to make special arrangements and take special precautions;

2. When the rolling stock has to be released quickly.

The release of wagons under present conditions, when there is an excess of rolling stock, is not so pressing. Some of the Railways report that provisionally they no longer give this preliminary advice, except in the case of foreign wagons, the object in this case being to reduce the dues to be paid.

If preliminary advice of arrival is given, everything must be done to avoid delay in having the wagon ready for the consignee as advised.

To this end such wagons are given priority and are specially labelled so as to bring them prominently to the station staff's notice.

Under these conditions the preliminary advice note has no practical drawback likely to encourage the railways not to give it each time it is of real value.

If there should be any delay the consignee is advised by telegram or telephone to stop him going to the station. If, however. he cannot be stopped in time, he is compensated equitably.

* * *

CHAPTER V.

Accelerated turn-round of empty stock.

Nothing new in the way of speeding up the turn-round of empty stock has been reported since the Cairo Congress in 1933, when the question was thoroughly investigated.

A few of the special methods used to speed up the turn-round may be recalled :

French Railways :

1. Preliminary advice of arrival;

2. Serving local stations outside the hours open;

3. More frequent checks over the railway, and daily statement drawn up by the stations, showing the average time wagons are kept standing;

4. Forming complete trains of empty wagons to run between distant points or important loading centres, such as ports, stations in industrial centres, etc.

5. Working special coal, ore and ballast wagons on fast timings drawn up so as to avoid standing.

Belgian National Railways Company :

1. The delay in the case of loaded wagons arriving at destination the last day of the legal period or later has to be justified by a card;

2. The allocation and removal of the available stock is dealt with continuously in accordance with fixed orders.

Netherlands Railways :

The traffic is accelerated generally.

Northern of Spain Railway :

The use of optional trains exclusively run for working empty stock.

* * *

Empty stock is only given priority over loaded stock under special circumstances.

It has been pointed out to us that great prudence should be displayed in giving empty stock priority. When there is a shortage of stock it is better to accelerate the loaded wagons, as after a time there is danger of drying up the supply by having too great an excess of loaded wagons.

When there are too few spare wagons at the using centres empty wagons are usually given priority.

When serving the yards by a shuttle service, or for feeding important loading centres, or for connecting widely separated centres, trains made up of empty stock alone are used. In normal working, the empty stock is distributed and cleared to suit by existing trains conveying loaded wagons.

* * *

Notice that stock required by consignors is available.

The regulations differ from one railway to another : the following is a summary of the principal ones.

— notice given by letter or telephone of the day and hour the wagon will be in position;

— notice only given when the wagon is not available as promised when ordered;

— notice given when the wagon is available and when it is not;

— notice given by ordinary letter, express letter, or telephone, the day after receiving the request, stating the day and hour the wagon will be available.

— notice given verbally when the request is received; if this date cannot be met it counts nonetheless for fixing the period within which the goods have to be delivered;

— no notice given whether the wagons are available or not.

* * *

Empty wagons are supplied to establishments working day and night, either at one time or in several batches according to the number required and local customs. The wagons are drawn at fixed times as agreed between the interested parties and to suit traffic requirements.

* * *

The consignees in principle do not as a rule advise the railway of the probable time the wagons will be cleared ; special arrangements, particularly with large establishments connected by private sidings, can be made to liberate the

stock at a suitable time for it to be worked forward by the first available train and without loss of time.

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CHAPTER VI.

Use of containers and road-rail vehicles.

A. — Containers.

1. *Use of containers by consignors.*

The use of containers for certain classes of goods is still in the experimental stage on most of the systems.

The number of containers in service is too small for drawing from their use such information as only a longer and wider experience can give.

We will therefore limit ourselves to summarising the information received. This shows that in the present state of the question definite conclusions as to the types recommended and the method of use cannot be formed.

The result of our enquiry is given in the following table :

Railways.	Type of container.	How supplied.	How conveyed.	Transport from station to consignee.	Re-use.
-ench Est Rys. . .	Open and covered, U.I.C. type.	Placed at consignor's disposal in station.	On flat wagons by slow goods trains.	Covered by consignee, delivery always being at station.	No information.
L.M. Rys. . . .	U.I.C. type.	Hired to consignors by the month or longer.	Like the wagons.	Either by the railway or the consignee.	Ordered by the stations requiring them.
O.-Midi Rys. . .	Large U. I. C. type.	Hired to consignors for a certain period.	Like ordinary consignments.	By the consignee; occasionally under certain conditions by the railway.	To the user's instructions and conveyed empty at reduced rates.
-ench Nord Ry. .	Open and covered U.I.C. type.	Hired to consignors.	By ordinary (slow) goods trains.	By consignee.	Returned to centre to which they belong.
-ench State Rys.	U. I. C., types 22, 42, 62, and 82.	Hired to consignors.	On flats by slow goods trains.	By consignee.	As arranged by hirer.
-sace - Lorraine Rys.	U. I. C., types 22 and 201.	Hired to consignors and put at their disposal in the station without charge.	Like ordinary goods.	By consignee.	Free empty for re-loading.

Railways.	Type of container.	How supplied.	How conveyed.	Transport from station to consignee.	Re-use.
Netherlands Rys.	U. I. C., large and small types.	Put at consignor's disposal by central distributor, without charge.	No reply.	No reply.	No reply.
Nord-Belge Lines	U.I.C., types 2 and 5.	Do.	By through or parcels trains.	By the consignee, or by the railway in the case of small containers.	At central c[illegible] troller's [illegible] posal at use.
Belgian National Rys. Co.	U. I. C. small type.	Do.	Always in covered wagons forwarded as other traffic.	By the consignee, or by the railway in the case of small containers, and collected without charge.	...

Control of container turn-round.

Railways hiring out containers to consignors for a period as a rule exercise no control on the turn-round of this stock.

The railways who do control the turn-round, in view of the small number in service, do so by means of cards showing the use made of them, kept by the office distributing the containers.

So far no systematic organisation for using containers has been introduced.

On the Belgian National Railways, which own a thousand small containers, the central wagon control, under the Head of the traffic department is responsible for the way they are used. A card is prepared for each loaded or empty container by the dispatching and receiving stations. These cards are sent to the central control which follows the movements of the containers.

As a result of studying these movements many stations have been given permanent orders to send empty containers to specified stations for re-loading.

2. *Use of containers by private firms to group consignments.*

Some Railways, such as the P.O.-Midi, French Est, Netherlands, Alsace-Lorraine, Nord Belge and Belgian National have not put containers at the disposal of firms grouping consignments. Others, such as the Paris-Lyons-Mediterranean, French Nord and French State hire containers to firms undertaking this work, but take no action as to the way the containers are used.

There are a number of firms on the French Est owning containers registered by the Railway Company. Other firms hire them from the Company at a rent of 2 to 6 francs per calender day.

3. *Use of containers by the railway.*

Up to the present the railways con-

sulted do not use containers for their own traffic.

The French Est and Paris-Lyons-Mediterranean have made trials which did not give the expected results, chiefly owing to the difficulty of handling containers at intermediate stations.

The Netherlands Railways, however, state that containers are in departmental use to facilitate handling at the main stations with tranship platforms.

This aspect of the question is undoubtedly of interest and as soon as there are more than enough containers to meet the customers' demands ought to be taken up without delay.

B. — Rail-road vehicles.

This type of stock is being tested experimentally on two of the railways consulted :

There are two systems :

Willème Coder (French) and Culemeyer (German), the latter not being used in any country covered by this report.

In the Willème Coder system the 4-wheeled covered railway wagon is made suitable for use on the road by fitting rims with tyres to the wheels on one axle, the other being raised clear by the tractor on which the other end of the vehicle rests.

The French Nord and Paris-Lyons-Mediterranean Railways made tests lasting some months and the arrangement showed itself satisfactory technically, i. e. the wagon ran well on both rail and road.

As the road code was altered after the tests had been started, the load the wagon could carry had to be reduced to 5 tons with a tare of 14. Under these conditions the Willème Coder wagon was much less attractive and tests were not followed up.

The French State Railways purchased some twelve Willème Coder wagons but the tests carried out were not comprehensive enough to give any accurate information as to the future use of these wagons.

* * *

CONCLUSIONS.

1. *The functions and internal working of shunting yards.*

Shunting yards should be organised to obtain perfect working with the lowest possible operating costs.

With this end in view the following principles must be kept in mind :

1. The various work to be carried out should be analysed and divided into the elementary operations, the time taken to carry these out being ascertained by a number of stop-watch timings.

2. These elementary operations should then be collected into groups representing working periods which can be worked at a given rate.

3. The rate selected should equal the period between shunts over the hump, as this period governs the efficiency of the yard. The speed the wagons are shunted into the sidings must not exceed that at which probable mistakes would cause more time to be lost than could be saved by the higher working speed.

4. A harmonograph of the different elements of the work, the whole of which forms the systematic organisation of the work in the shunting yard, should be drawn up.

5. The train service should take into account improvements which can be obtained from alterations in the timetables, as for example cutting out lost time and getting continuity in the operations in the shunting yard.

6. The shunting operations should not be carried out by guesswork, but the work should be planned to the greatest possible extent.

7. The actual sequence of the operations should be controlled by graphs in order to obtain information on which to improve any weak points in the organisation and to be able to work more closely to the programme laid down.

8. Incoming trains should be formed in such a way as to reduce the number of shunts.

8. For reasons of economy the work should be concentrated in one part of the day and at least one shift cut out, having regard of course to the user's interests.

II. — *Provision of inter-yard connections.*

The adoption of the following principles is recommended :

1. Regular inter-yard trains should be organised, either made up to the maximum load to reduce operating costs or run at higher speeds to meet competition from other methods of transport.

2. The organisation introduced should be supervised by a controller or dispatcher.

3. Optional trains at booked timings should be used to the largest possible extent to deal with additional loads.

4. The organisation of the supplementary trains should be under the controller or dispatcher who will watch their working as well.

III. — *Estimation of the probable traffic to be dealt with, and provision of the trains required.*

A knowledge of the traffic to be dealt with is so useful that the railways in their own interests should ascertain the factors on which to make a long-range forecast of the volume of traffic to be expected. Alternatively they should take steps to collect the same data on their own and their neighbours' lines sufficiently early to provide the requisite means.

IV. — *Information to be given to consignees.*

Arrival advice note.

In order to shorten the turn-round period of the rolling stock, the consignee should be advised as soon as possible of the arrival of his goods.

Goods-train timetables.

Under the present organisation of goods-train working, the customers cannot be notified with any degree of certainty of the actual time a given wagon sent off on a particular date will arrive. The railways can take steps to guarantee to work certain traffic, under certain conditions, by a fixed working and thereby guarantee the time of arrival at destination. In this case the customers can obtain a timetable of recommended services.

Advice of arrival.

When there is a shortage of stock, the consignee should be given the probable arrival time of the wagon. The advice notes are issued from the notices given by the previous stopping station.

V. — *Acceleration of the turn round of empty stock.*

In order to speed up the turn-round of empty stock it will be usefull to recall a few other means reported as effective, in addition to the conclusions come to at the Cairo Congress (1933) (1).

1. Preliminary advice of arrival should be given.

2. Empty-stock trains should be worked between distant stations and to important using centres.

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(1) See *Bulletin of the Railway Congress*, May 1933, p. 503.

3. The working of loaded wagons should be controlled.

VI. — *Use of containers and rail-road vehicles.*

We find that many railways who replied to our questionnaire have not yet definitely decided to extend the use of containers and are still using them on a small scale only, owing to various restrictive measures.

We think the more extensive use of containers is to be recommended as an effective way of meeting road competition.

In this connection the railways have every interest in studying the following questions :

1. Simple, practical, and cheap means of loading and off-loading containers on wagons and lorries so as to give door to door transport easily.

2. The rates for carrying empty or loaded containers.

3. The distribution of containers between the users.

4. Door-to-door collection and delivery under the same conditions as other small consignments.

Rail-road wagons are still in the experimental stage.

June 1936.

A comparative study of road motor transport regulations,

*(5th article *),*

by Vladimir IBL,

Engineer, Manager of Road Services, Czechoslovak State,
Vice-President of the Czechoslovak Commission on co-ordination of methods of transport.

FIFTH CHAPTER.

Special conditions, in the motor transport regulations, applied to State Railway of Post Office operated public road services.

1. — Exclusion of State interference in public road transport.

We saw in the previous chapter that the idea of the organisation of public motor services as a State monopoly has not been reflected in any motor transport regulation.

This raises the question whether, on the contrary, any of the regulations examined explicitely oppose the setting up and operation of public motor services by the State (more particularly by the State-owned Railways or Post Office) or its participation therein.

We may say that in none of the regulations examined are the two above mentioned administrations completely excluded from the field of public road transport, though there is, in certain regulations, a hint of their being partly excluded therefrom, namely in the two following cases.

Germany.

The *law of the 4th December 1934* (see our first article, p. 544) on inland passenger traffic forbids the State Railways or Post Office Administration to *organise occasional passenger road transport* in vehicles used exclusively for such a purpose, as well as free transport within townships.

In the case of road *goods* transport, which for the most part is occasional transport, the State Railways are not excluded from their part in it; in fact the *law of the 26th June 1935* recognises their participation in the case of long-distance goods transport by road.

France.

The decrees of the 19th April 1934, 25th February 1935, and 13th July 1935 (see first article, p. 547, and second article pp. 143 and 144) on co-ordination of rail and road transport in France consider the French main-line railways as one unit. The State-operated Railways (State and Alsace-Lorraine) under this legislation are assimilated to the main-line companies and share their lot. The restrictions imposed by this legislation on the main-line railways in a general

(*) See *Bulletin of the Railway Congress :* (1) May 1935, pp. 544 to 556; — (2) February 1936, pp. 130 to 149; — (3) June 1936, pp. 582 to 597; — (4) September 1936, pp. 916 to 930.

way also apply to the State-owned railways.

Now, in the case of *passenger* transport, the decree of the 25th February 1935, no section of which explicitely excludes the main-line railways from operating road passenger services, deals with the participation of the main-line railways in undertakings operating such transport. The clause in question stipulates that the main-line railways within a period of three years must cease to invest directly or indirectly any part of the « common fund » (*) in road transport undertakings which for the most part are subsidiaries of these railways. Railways which have contracted to invest part of the common fund in the working costs of such companies are required, in order to meet these requirements :

1. Not to renew any contracts terminating within the three-year period;
2. To use any opportunity offering within this same period under their contracts or by friendly negociations to terminate such contracts at once or at an early date.

In a word, the object of these regulations is to liquidate as soon as possible all such participations.

(On the other hand, contracts made between the main-line railways and their subsidiary motor transport companies or with other road transport undertakings in connection with motor services to take the place of railway traffic are to continue in principle until they expire if no financial contribution from the common fund is made towards the expenses of such services.)

(*) As regards the common fund of the French Main-Line Railways, the reader is referred to the Convention of the 28th June 1921 on the new articles regulating the operation of railways, approved by the law of the 29th October 1921 and fixing the conditions under which the State makes good any deficit in the common fund.

2. — Legal authorisation of the State Railways or Post Office to operate public road services.

In countries the legislation of which accepts the idea of a State *monopoly* of public motor transport, the State appears at first sight to be *implicitly* authorised to introduce and operate such services. But as we saw in the previous chapter (see 4th article, pp. 928/929), in **Rumania**, where this idea was expressed very positively (by the *law of the 15th October 1932)* a subsequent law of the *21st July 1934* was required to give the Rumanian State Railways the exclusive right of operating the public traffic monopoly over certain roads. The **Hungarian** *law No. XVI/1930* (see first article, p. 549) which in clause 5, though it stresses the idea of the State monopoly in the field of public motor transport, does not include any explicit authorisation for the State Railways or Post Office to operate such transport. Such right is taken into account, however, as the two Administrations are granted the prior right in the case of competition for a concession.

There are only a few cases in the other legislations considered, in which these two Administrations are *explicitely* authorised to take part in public road transport. These are :

a) Belgium.

The law of the *21st March 1932* regulating public motorbus and touring-car services (see first article, p. 546) includes a clause worded as follows :

The Belgian National Railways Company may be authorised to introduce, and if need be operate, motor road ser-

vices. It is also authorised to take a financial interest in such services.

This clause, if taken literally, seems to exclude the State Railways from organising passenger road services unless authorised to do so at a later date (although allowing them to take an interest in undertakings operating such services).

The actual position is that this Company only operates one motorbus service, whilst using a certain number of such services operated by firms with which it has a contract.

b) Bulgaria.

The *law of the 23rd April 1935* (see 3rd article, p. 582) authorises the State Railways to organise all kinds of motor services, either directly, or in the case of certain combined (rail-road) transport, in collaboration with private firms.

c) France.

The *decree of the 25th February 1935* on the co-ordination of railway and road *passenger* transport allows the main-line railways to invest capital in road services run in connection with the trains (such as connecting services between a station and the centre served by it, tourist services, etc.) as long as no independent firm has undertaken to work services at its own risk and peril on the basis of the division of traffic between the railway and the road. In addition, the railways can themselves work road passenger services alongside their lines still open to passenger traffic so long as this method of operation has been adopted to facilitate agreements between carriers and the necessary authorisations have been issued.

In the case of *goods traffic*, the *decree of the 13th July 1935* does not mention any similar authorisation.

d) Switzerland.

Switzerland must also be mentioned, as the *law of the 2nd October 1924* gave the Post Office the exclusive right to introduce and even operate public road passenger services.

None of the other regulations examined contain any such authorisation, but some of them *indirectly recognise the existence* of such services operated by one or other of these two Administrations by including certain clauses about such services.

Such is the case in Germany, Austria, France, Hungary, Poland, Czechoslovakia, and Jugoslavia.

(We will return to this subject when dealing below with the special conditions applicable to such services).

* * *

As the law is always a little behind the actual state of affairs, it is not surprising that the regulations examined, except in Belgium, France and Hungary, remain dumb on a matter of interest almost everywhere, which must grow in importance as the idea of co-operation replaces that of competition between railway and road. The point we have in mind is *the participation of the Railways in the setting up and operation of private motor transport companies.*

3. — Special conditions applicable to public road services set up or operated by State Railways or the Post Office(*).

We will now consider if in the other regulations dealt with in this investiga-

(*) It must be pointed out at once that we will devote a complete chapter to the part the Railway or Post Office are called upon to play, according to the clauses of certain of the regulations examined, in the administrative procedure laid down for the granting of concessions to private firms, as well as, if need be, the operation of their concessions.

tion, services organised by State Railways or the Post Office are completely on the same level as services operated by private firms, if they have to comply with the same regulations, or if these two Administrations come under a special or more favoured legislation.

Generally speaking, it may be said that among the regulations considered, very few give markedly preferential treatment to these two National Administrations. The others are content to give them unimportant facilities.

The situation is as follows (*) :

a) **Germany.**

It is interesting to see how ideas on this subject have developed in Germany between the end of 1931 when the ordinance of the 6th October 1931 (see 1st article, p. 544) regulating all interurban transport (passenger and goods) was promulgated, and the enforcement of the two enactments which replaced it, namely the law of the 4th December 1934 (see 1st article, p. 544) and the law of the 26th June 1935 (see 2nd article, p. 132).

The *ordinance of the 6th October 1931* did not apply to services organised by the Post Office, except as regards the following obligations :

a) publication of timetables and rates;

b) Uniform application of fixed rates to all passengers.

The introduction of such services depended upon an authorisation from the Minister of Communications. To this end the Post Office had to advise the Minister of Communications four weeks beforehand that it proposed to introduce a permanent regular passenger service ; the Higher Authorities of the district concerned and the State Railways likewise had to be advised. If within the four weeks the Railway raised any objection on the ground that its interests were affected, or if the aforementioned Authorities opposed the scheme as not in the public interest, the decision remained with the Minister of Communications in agreement with the Postmaster General, after hearing the State Railways and Higher Authorities of the district concerned. In case of opposition, the introduction of the service was to be deferred.

According to the clauses of the aforementioned ordinance, common to passenger and goods transport, it was stipulated that neither the Post Office nor the State Railways were obliged to take out an insurance covering the guarantees required for the operation of their road services.

Another clause put these services under the control of the Minister of Communications.

Apart from this, the ordinance made no distinction between services introduced by the Post Office or by the State Railways. It would seem therefore that the Railway, except in the matter of insurance, was subject to all the regulations in the said ordinance, and in the case of road services was in exactly the same position as a private firm.

The *new law of the 4th December 1934* on public *passenger* transport states on the one hand that it also applies to pas-

(*) In the following paragraphs we propose to summarise the essential clauses without mentioning the obligations of the private firms which the two National Administrations are not subject to, otherwise this article would be too long.

It should be remembered however that among the regulations on motor passenger transport examined, those in force in Belgium, Italy, Switzerland, and Rumania only deal with regular services, and that in the case of goods transport, there is no regulation of such road transport in Belgium, Switzerland, and Rumania up to the present.

senger transport worked by the Post Office, but on the other hand does not include the motor postal services in rural districts. It is stipulated therein that the Post Office and the State Railways do not have to obtain an authorisation to organise services over fixed routes nor for occasional transport worked in vehicles used for the former services. The Minister of Communications has to fix the extent and character of such occasional services.

Services over fixes routes as well as occasional services organised by the State Railways are under the control of the Minister of Communications; the latter services, when organised by the State Railways or Post Office, are not subject to the special provisions of the law on occasional transport. In the case of services over fixed routes organised by these two Administrations, the only obligation imposed on them is the publication of the transport rates and their uniform application. These rates, the transport conditions, and the timetables of such services have to be approved by the Minister of Communications.

When new services of this kind are introduced, whether by the State Railways or the Post Office, each must inform the other four weeks before the proposed service is to start, and the Higher Authorities of the district in which the proposed service will operate must also be notified at the same time. The service cannot be started without permission from the Minister of Communications if within the four weeks the abovementioned authorities decide it is against the public interest or if the other Administration declares it will suffer thereby.

In the case of *goods* transport, the law of the 26th June 1935, which regulates it, does not in general include the transport of post parcels and it is laid down that in the case of long-distance transport directly operated by the State Railways under the control of the Minister of Communications, the regulations do not apply except as regards the drawing up, publication and strict application of the rates.

b) **Austria.**

In the *special Austrian law of the 3rd October 1931* on public *motor services over fixed routes*, the Post Office and State Railways are definitely given preferential treatment.

The road services operated by these two Administrations do not have to obtain a concession like other undertakings, but must be authorised by the competent Minister. At the present time it is the Minister of Commerce and Communications who grants the authorisation for post office services or services introduced by the railway.

Before giving this authorisation, the Minister of Commerce and Communications — whilst having regard for similar regulations on the procedure laid down on granting concessions to private firms — must see that the proposed service meets public requirements, that the route is well chosen, and that the service is not against the general interest, particularly that the roads to be worked over are good enough to stand the traffic and that the service will not cause anti-economic competition with existing transport undertakings, such as railway lines and motor services parallel to it, as well as inland water routes, which already meet the real transport needs of the district in question or could be made to do so in a short time.

When it is a question of the Post Office introducing a line, the need for car-

rying the mails over this line must be taken into account.

In addition before he gives the necessary authorisation the Minister of Communications has to consult the chief government offical of the district concerned who will make what enquiries he considers necessary.

The authorisation may be for a given period or without limit.

For the Railways and Post Office is reserved the right to have the grant of a concession for a regular service deferred if one or other of them state that they themselves wish to work a service over the proposed route within a year at the most. If the consent of the Minister of Posts or the Minister of Commerce and Communications is obtained within 6 months, to organise the service in question, the two Administrations are entitled to have the application for a concession definitely refused.

The Post Office services are controlled by the Post Office Administration ; those organised by the Railway come under the Higher Authority of the district or province and finally under the Minister of Commerce and Communications.

The services in question are subject to the legal regulations.

The ordinance of the 9th June 1933 on *occasional goods transport* (other than that worked over fixed routes) do not give services organised by the Railway any preferential treatment; in fact such services are not even mentioned.

c) Belgium.

In Belgium in accordance with the *special law of the 21st March 1932*, the National Railways Company and the National Light Railways Company come under the common law in the case of public services operated by them or which they intend to operate. The omnibus services organised by the National Light Railways Company in order *to improve the working conditions of its railway system* alone are exempt from these regulations.

d) Bulgaria.

The *decree of the 16th May 1935* on motor transport undertakings makes no special provision for transport organised or operated by the State Railways or Post Office.

e) France.

First of all mention must be made of the *postal services* (motor postal services in rural districts, see 1st article, p. 548) which are exempt from the present regulations in force on motor transport in France.

In the case of services operated or to be operated by the *Main-Line Railways*, we would refer our readers to point 2 above, and need only add that no special treatment is provided for in the present regulations in favour of passenger services organised by the French State-owned Railways.

f) Hungary.

Law No. XVI/1930 reserves for the State Railways and Post Office the priority for concessions to operate public road services. This priority is abolished if the Administration concerned has not organised the said services within the period laid down by the Authorities.

The organisation of a service of this kind by one or other of these two Administrations depends upon an authorisation from the competent authorities, but the law stipulates that the obligations to be imposed in this authorisation must be adapted to suit the future operator. The law does not provide for particular faci-

lities to services organised by these two Administrations.

The same conditions apply to undertakings in which one or other of these Administrations holds the majority of shares.

It should be noted that, in accordance with law No. XVI/1930, the Hungarian Government has given the State Railways the exclusive right to operate motor *goods* transport on condition that the services are worked by an association of private operators under contract with the Railway. No preferential treatment is given such transport however.

g) **Italy.**

The Italian regulations make no mention at all of the Post Office or State Railways as operators of road services.

h) **Poland.**

The *special law of the 14th March 1932 (first article, p. 552)* and the decree enforcing it grant the State Railways and Post Office only unimportant facilities.

Among transport for which no concession is required the law mentions both parcels and other postal traffic, although such transport is not exclusively reserved to the Post Office, and the cartage of parcels and goods (luggage excepted) worked according to the regulations on the transport of passengers, luggage, and goods by rail. Apart from this the two Administrations are to be treated exactly like private firms when it is a question of introducing motor services. The only exception made in their favour, apart from those mentioned above, is that the two Administrations do not have to deposit a guarantee nor take out insurances to cover their operating responsibilities.

i) **Rumania.**

Until the *law of the 21st July 1934* came into force, the Rumanian legislation gave the State Railways and Post Office no appreciable advantages in this respect. As we explained in the previous chapter, these two Administrations could not introduce a public road service under their direct control unless the competent authorities had put up to auction the right to use a given route. The only advantage the *law of the 15th October* reserved for these Administrations was that when the State Railways or Post Office and Telegraph Administration took part in the auction, they could obtain the concession if the amount they offered plus 5 % was higher than that of their competitors.

The *law of the 21st July 1934* completely changed this state of affairs for the State Railways.

As has already been stated, this law authorises the Minister of Public Works and Communications to grant the Rumanian State Railways, for twenty years, the sole right to operate public road transport services over a certain number of routes without public auction.

The Convention passed in August 1934 in pursuance of the above law makes the matter clear in the following words :

The concession applies to 155 sections of road, most of which are parallel to the railway, the total length being approximately 11 000 km. (6 835 miles). On some of these roads where services are being operated according to concessions *granted at an earlier date* to private firms, the Rumanian State Railways will not take over the operation until the agreements in force expire or are cancelled. This will occur in 1936, as the above mentioned contracts terminate after a certain number of years (four at the most) after their signature.

On the other hand, private operators

with *temporary* licenses, granted *at an earlier date*, to operate services on sections of road now conceded to the Rumanian State Railways may continue to work such services as long as the State Railways do not make use of their right to organise a service themselves on the section of road concerned.

At the present time *no new provisional licence* can be granted to private operators over sections of road conceded to the Rumanian State Railways, not even if they have not yet begun to operate services on these sections themselves, except in specified cases.

The right to a monopoly on each of the roads conceded to the Rumanian State Railways comes to an end if within two years no regular permanent service has been organised on the section in question, or if the services are interrupted for more than two years.

The irrevocable term of the convention is twenty years.

In return for the exclusive right to use the sections of road in which they are interested, either because they are parallel to the railway or because they make it possible to organise connections for feeder traffic, the State Railways have to make certain contributions to the Minister of Public Works for the improvement and maintenance of the roads.

j) **Switzerland.**

The question of preferential treatment for the Swiss Federal Railways does not arise because the *law of the 2nd October 1924* gave the Post Office the exclusive right to work interurban passenger traffic by road, either themselves or through concession-holders, and no mention is made of the Federal Railways working services as concession-holders from the Post Office.

k) **Czechoslovakia.**

The new regulations on motor transport *(law No. 77 of the 12th April 1935*, see 2nd article, p. 136) in actual fact give the State Railways or Post Office the preference in setting up and operating their own road services.

The State Railways and Post Office can organise public motor services without a licence. Each of these Administrations has the priority for organising regular services, for which a private firm has to apply for an authorization.

The Administration in question must however take advantage of this privilege within two months of being notified by the competent authorities that the preliminary enquiry is in favour of the applicant. The concession is granted to the private operator after this period if one or other of the two Administrations has not made use of the right to priority. If the right has been claimed but the Administration has not organised within three months the service for which concession was asked, the concession is to be granted to the private operator. The Administration introducing a new regular service has to inform the competent authority.

Services organised by one or other of these two Administrations are exempt from certain administrative formalities laid down in the special regulations and the enforcing decree; on the other hand they incur certain obligations as to organising and working the traffic (for example, obligation to carry traffic and to maintain an uninterrupted service except in unforeseen cases, to publish regulations, timetables, and rates, and to inquire into the state of the roads, etc.).

With two unimportant exceptions, the *law of the 12th April 1935* does not introduce preferential treatment for services

organised by one or other of these Administrations as regards the taxes borne by the vehicles used for such services, and passenger traffic by motorbuses or tourist cars.

l) Jugoslavia.

The *law on transport companies* (see first article, p. 555) stipulates that a concession is also required in the case of services operated by the State, except those directly operated by the Ministry of Communications for its own requirements.

The other enactments and practice make it clear that no preferential treatment is given in Jugoslavia.

* * *

It seems to us that the way the regulations examined treat the participation of State Railways in road transport as described above would be made clearer if the present situation as regards such activity were summarised.

In this connection the following data are available :

1. Results of an inquiry undertaken by the Third Commission of the International Railway Union (U. I. C.);

2. Statistics of the motor services of Members of the U. I. C.;

3. Information supplied by the Railways to the Permanent Reporters of the U. I. C. on the question : « Competition and co-operation between the railway and the road. »

Although the information is incomplete, we will endeavour to deduce certain conclusions therefrom.

The inquiry undertaken in 1935 by the Third Commission of the U. I. C. amongst its Member Administrations included amongst others the following question :

What methods of operating railway motor services do you resort to ?

Class *a* : Services *directly operated* by the railway;

Class *b* : Services operated by subsidiary companies in which the railway has a *financial interest;*

Class *c* : Services operated by *independent firms under contract* with the railway, which do or do not receive a subsidy from the railway;

Class *d* : Other methods of operation.

The State Railways of the countries dealt with in the present study replied as follows :

1. *Germany.* — The German State Railways partly operate services themselves (class *a*) and partly in common with the Post Office and other undertakings (class *c*).

2. *Austria.* — The Austrian Federal Railways work some of their services themselves (class *a*) and some through a private company (class *c*);

3. *Belgium.* — The Belgian National Railways Company only operates one service itself (class *a*); several other services are worked on its behalf on contract by lessees or other carriers (class *c*);

4. *Bulgaria.* — The Bulgarian State Railways do not operate any road services themselves up to the present;

5. *France.* — The general reply received from the French Railway Companies also applies to the State Railways and Alsace-Lorraine Railways. No services are directly operated by the railways; their services are operated by subsidiary companies in which the railways are financially interested (class *b*). Other ser-

vices are worked by independent firms whose relations with the railway are not very clearly explained in the answers given (class *d*);

6. *Hungary.* — The Hungarian State Railways only operate their motorbus services themselves (class *a*). In the case of goods transport they employ a private company (class *d*);

7. *Italy.* — The Italian State Railways do not operate any road services themselves, but make use of the National Transport Institute, an organisation three quarters of whose capital is owned by the State (class *b*);

8. *Poland.* — The Polish State Railways state that they themselves operate some road services (class *a*);

9. *Rumania.* — The Rumanian State Railways replied that they themselves operate some road services (class *a*);

10. *Switzerland.* — The Swiss Federal Railways state that they employ for cartage and other supplementary services a firm in which they have a financial interest;

11. *Czechoslovakia.* — The Czechoslovak State Railways operate road services themselves (class *a*), and in addition have a financial interest in a transport firm (class *b*);

12. *Jugoslavia.* — The Jugoslav State Railways do not operate road services themselves as yet.

* * *

The *Statistics of the railways' road motor services* published in No. 5 (1935) of the *U. I. C. Bulletin* only include, as explained in the introductory notice, services operated by the Railway Administrations or under their direct control, so that firms in which they merely have a financial interest as well as haulage and cartage services in urban districts are excluded.

In the countries dealt with in these articles the present position is as follows :

Statistics of road motor services operated by Railways in 1935.

COUNTRIES.	Number of vehicles used.		REMARKS.
	passenger.	goods.	
Germany	46	2099 (*)	(*) Including vehicles used for the railway's own business.
Austria	197 (*)	...	(*) Austrian Federal Railways' services operated through their affiliated company (K. Ö. B.).
Belgium	50	...	...
France : Alsace Lorraine	18 (*) 13 (**)	4	(*) Services replacing passenger trains. (**) Tourist services.
State Railways	17	...	
Hungary	117	20	...
Poland	115	...	...
Rumania	29	...	...
Switzerland	...	120	...
Czechoslovakia	719	183	...

Notes :

In spite of the exact definition of these statistics given in the explanatory notice mentioned above, it would seem that the figures are somewhat heterogeneous, i.e. they include in addition other classes of vehicles than those used in services directly operated by the railway.

In the case of *Austria* it is definitely stated in the statistics themselves that the number refers to vehicles used in services worked by a company affiliated to the Federal Railways.

As for *Germany,* the situation is as follows :

« According to the publication « Tatsachen und Zahlen aus der Kraftverkehrswirtschaft » for 1935, the State Railways in 1934 owned 13 omnibuses and 683 lorries used in services with fixed routes and timetables. But according to the same source 192 motorbuses and 1 229 lorries were used altogether (including the former vehicles) in this railways' road services, which to a great extent were operated by affiliated firms. »

The position would therefore have to be made clearer before it could be stated positively that the whole of the 2 099 lorries actually belong to the German State Railways.

In the case of *Belgium,* the aforementioned enquiry shows that the Belgian National Railways Company only operates a single service itself, whereas the statistics mention 43 lines without any further information about them. An earlier note published in No. 7/8 1934 of the *U. I. C. Bulletin* says definitely that only the Brussels-Charleroi line is operated by the railway itself, and the other omnibus services introduced by the National Railways Company and duplicating its railway lines are operated either through a contractor bearing the costs and retaining the receipts subject to payment to the railway of a percentage of the gross receipts, or by a firm which supplies the rolling stock and staff and receives so much per kilometre from the National Railways Company, which takes the receipts.

From the 1935 report of the Board of Management, the Belgian National Railways Company would appear to own about 200 motor goods vehicles, but most of this stock is being used for the collection and delivery of rail-borne traffic (small consignments and post parcels). The only motorbus line mentioned above, was leased out to a private firm in 1935, and the four buses used on the line have been sold.

As regards *France,* it seems that the information in connection with the two State-owned railways only applies to services worked by their subsidiary companies.

In the case of *Hungary,* the statistics give no precise information about the kind of services for which the vehicles are used. One is tempted to infer that only services *directly* operated by the railways are in question, which in the case of the motor lorries contradicts the information given in the introductory note.

The above remark also applies to *Switzerland.* It should be remembered that in Switzerland a company operating transport services in conjunction with the railway services (SESA) has been in existence for some time and in particular covers cartage work. In 1933, at the request of the Federal Railways, this firm organised a special service known as the « ASTO » (Automobil Stückgut Transport Organisation) which serves towns and villages some distance from the railway, and delivers parcels along the railway between two of the large stations at which the goods trains stop.

In the case of *Poland, Rumania,* and *Czechoslovakia,* the figures given in the statistics agree with the information supplied by the inquiry. It should be pointed out, however, that the Czechoslovak State Railways share in the management

of a joint company operating public motor passenger transport services in Bohemia, and own 51 % of the capital.

This information shows that greater exactitude is required in defining the idea of « direct operation » immediate control or working of road services by the railways, either « by themselves » or « through subsidiary companies ». This lack of precision possibly is the reason why, as mentioned in the last paragraph of the previous point, the regulations contain no special conditions for road operators *co-operating* with the railway.

The facts mentioned in this chapter may be summarised with advantage.

I. Only two of the regulations examined *partially* exclude State Railways from participating in public road transport, and in both cases only as regards passenger transport. In the first case (Germany) only occasional transport is excluded, while in the second case (France) only public services with fixed timetables and routes (other than those organised by the railway in default of private initiative, parallel to or acting as feeder services to its own lines).

II. The State Railways are *authorised* explicitely to organise public road services for themselves by the Belgian, Bulgarian, French and Rumanian legislations. (In Switzerland the Post Office is authorised to operate passenger services).

The State Railways are also authorised to *participate* in private motor transport undertakings.

III. *Special regulations* on the introduction and operation of public road services by the State Railways themselves are laid down in the legislation of the following countries :

Germany, Austria (passenger transport only), Belgium (passenger transport only), Hungary, Poland, Rumania, and Czechoslovakia.

The chief facility such services enjoy is the exemption of the railways concerned from obtaining a concession by the same procedure as other applicants. This is the case in Germany, Austria, Belgium (only for certain services organised by the National Light Railways Company), Poland (only in the case of goods transport worked according to the same regulations as railway transport), Rumania, and Czechoslovakia.

The usual procedure prescribed to obtain a concession in two of the above cases is replaced by the obligation of obtaining authorisation or consent from the Minister of Communications (in Germany for occasional passenger transport, and in Austria).

Regulations which definitely favour the operation of road services by the State Railways are in force in those countries where the law gives them priority rights for organising public road services, the concession for which has been applied for by other applicants. This is the case in Austria, Hungary, and Czechoslovakia.

Services operated by the State Railways, without the ordinary authorisation that has to be obtained by other parties, are naturally exempt from most of the obligations imposed by the concessions usually based on the general legislation on transport undertakings. Sometimes it is explicitely stipulated that the State Railways, when operating road services, shall not be subject to these general laws. Their services are usually under the control of the Higher Administration over them.

On the other hand, with a few exceptions, such services are in the same posi-

tion as other public road services as far as safety regulations and taxation are concerned.

Conclusions.

The information given in this chapter shows how very differently the various countries assess the rights to be reserved for the State Railways when regulating public motor transport. Perhaps this diversity which leads to very different treatment of the road services organised by such railways is due to a great extent to the varying interest the State Railways of these countries have in organising their own road services to supplement or to replace their railway services, and in reaching reasonable co-operation with private firms or else taking an active part in working them.

It would seem, however, that the idea of organised co-ordination between railway and road transport has already made sufficient progress for a more or less general formula to be found which will define the activity of State Railways in the field of road transport and bring them into closer touch with private transport firms thanks to a freely assented co-operation.

* * *

CHAPTER SIX.

Special regulations for certain classes of public road service operators.

(Private railways, waterways, airways, local authorities, etc.)

Note :

As the previous chapter was devoted to the State-owned Railways and Post Office, these two national bodies will not be dealt with in the present chapter.

This chapter only deals with *public* services or those services which can be considered as such, consequently we will not deal with the regulations on *private* transport, particularly those on the transport of goods by factories, for example, commercial firms, etc.

Account must also be taken of the fact that amongst the regulations on passenger motor transport we have examined, those in force in Belgium, Italy, Switzerland and Rumania only deal with regular services, and on the other hand in the case of goods transport there is no regulation of road transport in Belgium, Switzerland and Rumania to date.

In the following paragraphs we will mention *all* the kinds of undertakings which enjoy special privileges in the regulations examined. To make the matter still clearer it must not be forgotten that the object of the present chapter is to discriminate according to the *operator* and not according to the *kind* of transport worked. Transport of a given kind therefore will be treated differently according to the class of operator.

The situation in the different countries is as follows :

1. Germany.

In the case of passenger transport, the *law of the 4th December 1934* recognises no special treatment apart from those of the Post Office and the State Railways. Omnibus services organised by townships within their own limits appear to be subject to these regulations without restriction.

The *law of the 26th June 1935* on road goods transport over long distances, which does not affect transport worked by townships within their own limits, makes no special distinction in favour of any given class of operator.

2. Austria.

The *Austrian law of the 3rd October 1931* regulating passenger and goods motor transport over fixed routes, does not apply to transport within townships. Special conditions are imposed on the following classes of service which do not require a concession :

a) Regular services organised by a *private railway;*

b) Services organised by certain establishments (for example, manufacturing firms) with the sole object of carrying their employees to and from work;

c) Services organised by *hotels, boarding houses, sanatoriums,* and other similar institutions to transport their clients and their staff between their premises and the stations, halts, and ports serving them;

d) Cartage services for goods transported or to be transported by public undertakings, such as the railways.

The decree of the 31st March 1931 instituting concessions for goods transport by motor dispenses from this obligation forwarding agents who had already been authorised to carry out this work before the law came into force. Those who obtained their authorisation later on will not have to obtain a concession under this law if they only carry out cartage work to a station or river port or air port and vice versa, as well as to their own depots in such stations if the forwarding agent is named as the consignor or consignee on the way bill or similar document. Forwarding agents are also free to transport agricultural produce and forestry goods as well as fuel without a concession if the load does not exceed 1 000 kgr. (2 200 lb).

The decree of the 9th June 1933 on the observation of minimum rates for public goods transport by road makes no distinction as regards the operator.

3. Belgium.

The *law af the 21st March 1932* regulating public motorbus and motor charabanc services does not apply to services organised by an *employer* for the sole use of his staff or family, and makes no distinction according to the operator.

4. Bulgaria.

The *law of the 23rd April 1935* on the organisation of motor communications (see third article, p. 582) merely reserves for municipalities the exclusive right of organising public transport services within their administrative boundaries, worked either by themselves or through contractors. Apart from this, these regulations do not admit any particular treatment.

5. France.

Please refer to the previous chapter for information about the *Main-Line Railways.*

Railways other than main-line railways as well as tramways were favoured by the *decree of the 25th February 1935* in that they are not forbidden by the regulations on co-ordination to organise public motor services to replace their railway services if such road services serve the same places as the railway and follow more or less the same route.

We must also mention *subsidised road services* (usually subsidised by a Department with State assistance) worked according to a contract and standard specifications (see first article, p. 548). We explained in our first article that such

services were authorised to continue working on this basis without infringing the *law of the 19th April 1934.* However, the *decree of the 25th February 1934* does not explicitely exclude such services; undertakings of this kind are represented on the Central Co-ordination Committee as well as on the Departmental Technical Transport Committees, and the regulations laid down in this decree for making agreements between carriers and passengers and the apportioning of the traffic between railway and road only favour these services to a very small extent.

As for the motor *omnibus* services serving *urban centres*, i. e. the town itself and its suburbs, even though these are not absolutely continuous to the town, these are to be treated in the same way as local passenger services within the said centres.

In conformity with the *decrees of the 19th April 1934* and *25th February 1935* on the co-ordination of railway and road transport, transport worked by any industrial or commercial firm, farmer, or private individual for their own business is not included in these co-ordination regulations when it is a question of passenger transport on condition that the vehicles used do not carry anyone except *persons connected with the business in addition to the driver.*

The *decree of the 13th July 1935* co-ordinating goods transport does not include any special regulations on public transport based on the capacity of the operater.

6. Hungary.

Law No. XVI/1930 regulating public motor transport undertakings gives inland navigation firms as well as *communes* the right of priority in obtaining concessions for public road services, which are to be granted them under the same conditions as to the State Railways and Post Office. In the case of transport worked within urban centres, traffic worked by forwarding agents is excluded from the benefit of these regulations. No other special regulations are included in the law, unless the clause reserving certain facilities to companies set up exclusively to operate road services be considered as such.

7. Italy.

The *law of the 20th June 1935* regulating motor goods transport gives *priority* rights to *private railways, tramways, funicular railways* and *inland navigation* when competing for the concession of a new motor goods service, if this service will take the place of their lines, duplicate them, or complete them. If several such transport undertakings are in competition, the Minister of Communications has to decide to whom the concession shall be granted.

8. Poland.

The *law of the 14th March 1932* on professional passenger and goods transport (see first article, p. 552) makes a concession unnecessary in the case of :

1. Free services organised by an *employer* to carry his employees and workmen between their homes and his business premises in his own vehicles;

2. The transport of school children between their homes and the school in vehicles owned by the *school* or hired by it for this purpose;

3. Tourist traffic worked by means of vehicles of the above mentioned category;

4. Occasional transport for excursions organised by *tourist associations.*

Municipalities (townships) may with

the consent of the Minister of Communications extend their omnibus services outside their own boundaries to neighbouring places without having to get a concession.

(The concessions required for public motor transport services within townships will be the subject of a special law).

9. Rumania.

The *law of the 11th June 1930* modified and amplified by the *law of the 15th October 1932* (see 1st article, p. 553) reserves monopoly rights for communes in organising public motor services within their territory, similar to the State monopoly over the public roads which we dealt with in the 2nd Chapter of this article. Apart from this no special provision is made in this law for townships or other operators.

10. Switzerland.

This question does not arise in Switzerland where as yet there is no regulation of public motor transport.

11. Czechoslovakia.

Law No. 77/1935 of the 12th April 1935 makes *special arrangements* in the case of :

a) Private railways;

b) Air companies;

c) Townships.

a) A *private railway* can only ask for a concession to start a public service with the consent of the Minister of Railways, and, when operated by another railway, with the consent of this railway as well.

On the other hand, private railways must be informed when a public carrier proposes to organise a regular public service, as they have priority rights for such a service (like the State Railways). The procedure is as follows :

The Minister of Railways, when asked to grant a concession, decides if any given private railway will be affected by the proposed service. If so, he informs the railway concerned that it can make use of its priority right. If the railway in question is operated by another railway, the invitation will be addressed to the operating railway which can take up the priority right.

The owning railway or the operating railway will make use of this right through the Minister of Railways and with his consent. They have to ask for the concession in question within a given period.

Apart from this, road services organised by private railways are subject to all the regulations laid down in the law, except when they wish to organise passenger or goods transport services between their stations and places served by their lines. In this case they can set up the services without asking for a concession, if the Minister of Railways approves.

b) Air Companies do not need a concession for services organised to bring passengers or goods carried by air from the airport to the town it serves and vice versa. Such services are exempt from the tax on motor transport, if the tax on the service is included in the air transport tax.

c) Townships likewise do not have to get a concession to organise regular public transport within their territory, or even beyond it to the station serving it if this lies in the next locality. Such transport is exempt from the tax on the tickets sold.

With the Minister of Railways' permission, townships can organise without

a concession omnibus services as far as 5 km. (3.1 miles) outside their territory.

In addition the following undertakings do not have to get a concession :

Medical institutions (sanatoriums, etc.) to carry the sick and stores consumed by them in vehicles specially intended for this;

Operators whose exclusive work is to *carry mail bags and parcels* according to a contract made with the Post Office;

Cartage firms under contract to the railway for transport between the stations and the places served by them.

12. Jugoslavia.

According to the regulations of the 16th May 1935 (see 2nd article, p. 137) explaining how the law on professional firms is to be applied to regular motor services, the following kinds of transport are not considered as regular transport, and consequently do not need a concession :

1. Services operated by *hotels, boarding houses* and similar establishments to transport their clients between their premises and the railway station, sea or river port, or airport serving them;

2. Services organised by an *employer* to transport his staff from their homes to their place of work.

SUMMARY.

As we have seen above, special provisions apply to road services organised by :

a) Private railways :
in Austria, France, Italy and Czechoslovakia;

b) Inland navigation companies :
in Hungary;

c) Airways :
in Czechoslovakia;

d) Townships :
in Bulgaria, France, Hungary, Poland, Rumania and Czechoslovakia.

The following *passenger transport* is not considered public and therefore does not come under the regulations on motor transport :

1. Organised by an *employer* to transport his staff :

in Austria, Belgium, France, Poland and Jugoslavia;

2. Organised by *hotels, boarding houses* and *nursing homes* to carry their clients :

in Austria, Czechoslovakia and Jugoslavia.

The Polish regulations include in this category certain kinds of transport organised by *educational institutions* or *tourist associations.*

In the field of *goods transport,* special arrangements are made for :

a) Forwarding agents in Austria; *cartage contracters,* in Czechoslovakia;

b) Operators exclusively working *mail bags and parcels,* in Czechoslovakia.

The idea of a special or privileged treatment of transport undertakings whose road services are worked in collaboration with railway transport, water transport, and air transport, or of undertakings and institutions of public interrest which work road services in addition to their proper activities, has, as the above summary shows, not developed uniformly in the various countries with which this article deals.

[625. 23 & 669]

Successive stages in the use of aluminium alloys in rolling stock construction,

by Mr. LANCRENON,

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During the last forty years railway rolling stock has been steadily improved as regards comfort and safety. Corridors, lavatories, bogie vehicles, steam heating and electric lighting, steel construction in place of wood, are all improvements much appreciated by the public. The drawback of all these innovations has been the greater tare weight per seat.

During this period the tare weight per seat has increased by 290 % in the case of 1st and 2nd-class accomodation, and 450 % in the 3rd. It has reached 1 ton per passenger in express train stock and 5 tons in the latest Sleeping-Car Co. stock.

As each train has to have sufficient seats available, the increase in weight per vehicle has resulted in heavy train loads and this in turn requires heavier and heavier locomotives to haul them, and heavier rails (50 kgr./m. = 100.8 lb. per yard instead of 30 kgr./m. = 60.5 lb. per yard), on which they can run.

The railways and rolling stock builders have thoroughly investigated the possibilities of keeping the weight down and a number of bodies have been built in the form of welded tubular girders and lattice girders, the weight of which per passenger is approximately the same as that of wooden construction of equal comfort.

It was therefore natural to turn to the light alloys as affording an elegant method of lightening the stock.

We propose to go over the stages of this evolution by giving a number of characteristic examples and to show the dependence of this progress on the development of aluminium and its alloys.

The first use on any scale dates from the beginning of 1923, when aluminium metallurgical practice was still imperfect. The manufacturers were still unable to meet railway requirements and pure aluminium had to be used. As the mechanical properties of the metal were relatively low, the sheets could only be used as panels, without adding to the strength of the body, as partitions, or as castings in interior fittings.

The Nord Railway (France) was the first to use light alloys in this way. Nearly three tons of light alloys were used on each of 12 steel bogie coaches weighing empty 47 to 50 metric tons, according to the interior layout, and they effected a reduction of 4 to 5 tons per coach.

In this case pure aluminium was used in the form of sheets for the roof, the outside and inside panelling of the body ends, and the inside panelling of the corridors and compartments. Many Alpax (13 % silicon) castings were used as interior fittings (seat frames and supports, luggage racks, locks, window frames, lighting fittings, etc.). An interesting example is the hinged doors of the compartments; these doors are difficult to make in steel owing to the turn under but

the problem was solved at a reasonable cost by using Alpax castings.

The first application shows how important the question is. Rapid progress has been made in light alloys and, by the end of 1923, high-strength light alloys, such as duralumin with mechanical characteristics approaching those of steel, with a breaking strength of 40 kgr. (25.4 Engl. tons per sq. inch), were so far developed that they came into use in rolling stock construction in the United States and Europe almost simultaneously.

The *Illinois Central Railroad* built at that time 25 suburban coaches in which light alloys have been used extensively. This Company now has 140 rail motor cars and 120 trailers built in 1923 and 1924 the weight of which is 84.2 t. (83.0 Engl. tons). The use of light alloys has reduced the weight by 8 125 kgr. (17 900 lb.) per rake (power unit and trailer) and 1 800 kgr. (3 970 lb.) on the engines, or about 10 tons in all. Aluminium alloys were used for the doors, inner and outer roofs, piping, and inside panels, representing 3 tons of metal.

In France, the Paris-Orléans Railway designed and built electric motor coaches for suburban services with duralumin outer roofs and partitions, the weight of this metal being 560 kgr. (1 235 lb.) per vehicle. The same type of construction has been used for the last 13 years, and over 200 vehicles put into service without the behaviour of this metal having given rise to any criticism, even in the oldest vehicles.

The International Sleeping-Car Company investigated as long ago as 1925 the possibility of reducing the weight of its vehicles from 57 to 50 tons. This was done largely through using 1-mm. (0.039 in.) thick duralumin sheets for the roof and Alpax castings for the interior fittings. The tare weight of the 90 vehicles of this type built in France and in England is only 48.5 t. (47.8 Engl. tons).

The German attempts, rather risky at the time, to make the use of aluminium alloys general in railway rolling stock construction must be mentioned. The *Metallgesellschaft*, in 1926, prepared, for the Berlin metropolitan railway system, complete designs for motor coaches with light alloy bodies and bogie frames.

Such an extensive use of these metals, especially in the vital parts of a coach, at that time was likely to be questioned, and the *Reichsbahn* Engineers, thinking it better to go slower, decided to build 8 experimental vehicles, in which the frame members and bogie frames were of steel, and the body framing inner and outer panelling, floor and interior fittings (brass work, window frames, cast doors, etc.) were made of light alloys. This partial solution was interesting as the reduction in weight was as follows :

	Old vehicles.	Lightened vehicles.
Motor coach	45.4 t. (44.8 Engl. tons)	34.35 t. (33.8 Engl. tons)
Trailer	33.9 t. (33.4 Engl. tons)	23.18 t. (22.8 Engl. tons)

The *French State* Railways, in 1929, wished to order 300 suburban vehicles and as they had to carry a heavier traffic the length of the trains had to be increased whilst using the same locomotives. It was, therefore, very desirable not to increase the total weight of the train in spite of the addition of a coach. By using light alloys to the extent of 1 500 kgr. (3 300 lb.) per vehicle in the roof, inside and outside sheeting, window frames, commode handles, and Alpax sliding

doors, the weight was reduced by 4 850 lb. and the same engines were able to haul 9 instead of 8 vehicles.

In 1933, this method had in its turn become inadequate and as the length of the trains could not be increased, the State Railways had to get out designs of new stock to form trains of the same weight and length as the existing stock but with much greater carrying capacity.

The solution was the double-deck vehicle weighing only 47 t. (46.25 Engl. tons). The eight-coach train can carry 2 040 passengers, whereas the train of nine 39-t. (38.4 Engl. tons) vehicles could only take 1 508. For an increase of 25 t. (24.6 Engl. tons) in weight per train, 500 additional passengers can be carried. This result has been obtained by a composite construction using high-tensile steel in the body side framing and light alloys in the superstructure. The side and roof sheeting, which takes part of the load, is made of 2-mm. (0.079 in.) and 1.5-mm. (0.059 in.) duralumin sheets respectively. The roof sheets are riveted to duralumin carlines. This alloy was also used in the form of corrugated sheets for the floors. The corrugations are filled with cork and the whole covered with a sheet of Insulite over which the linoleum is laid. The inside panelling is made of 1 mm. (0.0395 in.) thick almasilium.

The decorations and interior fittings are in light alloys as are the doors.

The 4 900 kgr. (10 800 lb.) of light alloys used have reduced the weight by 8 360 kgr. (18 430 lb.) An increase in weight of 8 360 kgr. would have made it necessary to use 6-wheeled bogies and the vehicle would have weighed nearly 60 t. (59 Engl. tons) although it would have carried fewer passengers.

A train of 8 such vehicles was put into service on the Paris-Argenteuil-Conflans line in 1933 and the results obtained were so good that the State Railways ordered more new units in 1934, bringing the total number up to 50. These vehicles have given complete satisfaction ever since they were put into services. At the present time the trains consist of 5 vehicles, are 116 m. (380 ft. 7 in.) long, and carry 640 passengers seated and 590 standing (1 230 in all) for a total tare weight of 235 t. (231.3 Engl. tons). The dead weight per passenger is therefore :

367 kgr. (809 lb.) per passenger seated,

191 kgr. (421 lb.) per passenger seated + standing.

Finally the question of lightening the rail motor cars was raised in 1930. These vehicles do not have to stand buffing stresses and, with the engines then available, had to be as light as possible. Naturally, therefore, the designers' thoughts turned to building the bodies entirely of high-tensile light alloys, especially as there had been much progress in their manufacture and there was no difficulty in getting such important parts as sole bars, for instance.

The *Midi* Railway was the first to build a vehicle of this kind, the design being based on the box girder principle; duralumin was used thoughout, and the weight was only 110 kgr. (242.5 lb.) per passenger.

The builder, encouraged by the way this vehicle stood up in service, continued on the same lines and built some 30 railcars for the different French main-line railways.

In spite of all fears to the contrary, these cars have given excellent service, thereby proving that light alloys can be used in railway work, and that the weight saving was of value as it reduced the effects of reactions and shocks from the rails. A number of these railcars have

now run over 200 000 km. (124 000 miles).

These vehicles, although not specially designed to resist collisions, have behaved very well in accidents, and were repaired as easily as steel stock. It appears that this is to be attributed to the lower tare weight and the resulting lower kinetic energy at equal speeds, as compared with a heavier railcar, and also probably to the low elastic modulus of aluminium alloys. The result is that details in light alloy specially designed to resist local buckling can stand up very well to shocks and this has been proved in service.

In 1934, all-light-metal articulated railcars were introduced in *America*. The United States also were first to build all-light-alloy main-line stock for express trains. In 1932/33 the *Pullman Car and Manufacturing Corporation* built two carriages in light alloy, including the bogie frames. The weight saving was some 50 % as compared with the standard design. Rivetting was used for all connections.

In France, the progress made in welded steel construction induced the Nord Railway to apply the same principles when using aluminium alloys.

This railway was the first to use welded steel stock and designed, as early as 1929, vehicles in light alloys on the same lines. At that time the only alloy available was duralumin and as it must be heat-treated, certain difficulties arose. The welded zone consisted of metal of relativity low mechanical strength which could only be improved by hammering, which proved difficult to do after welding. Besides, to restore the metal in the zones around the welds to heat-treated conditions, very bulky parts would have had to be heat treated, which was impraticable.

There was little chance of dealing with the problem until an alloy with suitable mechanical properties not requiring heat treatment was available. The alloy ultimately used was that containing 7 % of magnesium. This alloy in the annealed condition gives the following mechanical properties :

Tensile strength : 30 to 34 kgr./mm^2 (19.05 to 21.58 tons per sq. inch).
Elastic limit : 16 to 22 kgr./mm^2 (10.16 to 13.97 tons per sq. inch).
Elongation : 22 to 28 %.

Designs were consequently prepared in 1933 for coaches with the bodies made entirely of light alloys, and arc welded. These coaches built for suburban services in general layout much resemble the welded steel stock built in 1927. The weight saving was so great that one common bogie could be used under the ends of two coaches. The unit consists of 3 bodies carried on 4 bogies, the weight on any bogie not exceeding 30 tons or 15 tons per axle under full load. The body consists of a number of aluminium alloy pressings arc-welded together and to a rolled bar intended to reinforce the tubular girder so obtained. The body is carried on a welded steel fish-bellied frame.

The complete intermediate body weighs 15 800 kgr. (34 830 lb.) and the outer bodies 19 600 kgr. (43 210 lb.). The total weight of the train is 75 t. (73.8 Engl. tons), including *17.5 t. (17.2 Engl. tons) for the bogies; 17 000 kgr. (37 480 lb.) of light alloys are used in this design.*

The train provides seating accommodation for 274 seated passengers and standing room for 260, which is equal to a load of 40 tons. The weight per seated

passenger is therefore only 275 kgr. (606 lb.).

Static deflection tests have been carried out on the steel girder frame alone and on the frame with the outside sheeting in place. The deflections under a 30-ton load were in the ratio of 1 to 2. The light metal body therefore provides half the strength of the unit.

Before being used in suburban working, for which they were built, the coaches were tested at 140 km. (87 miles) an hour, and ran perfectly. The Nord Railway intends to build shortly a new coach with an all-light-alloy body, the underframe and roof being rivetted and the sides welded as before.

This review shows the importance of light alloys in railway rolling stock, and the benefits the improvements in the metallurgy of aluminium and its alloys can offer.

[625. 2 & 669. 1]

Building lighter metre-gauge rolling stock,

by A. de GOICOECHEA,

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SUMMARY. — Suggestions, supported by practical examples, on the methods by which the larger metre-gauge railway companies can lighten their rolling stock so as to carry cheaply and quickly larger paying loads and thereby not only retain their present traffic but recover that already lost.

By making its rolling stock too heavy the metre-gauge railway, which plays so important a part in the transport industry, has not only made the mistake of increasing the non-paying weight, but has also forgotten to some extent its real object. The metre gauge has become in fact too heavy, costly, imperfect, and irrational a means of transport for present-day needs, and has to face the future under such adverse conditions.

As this article is intended for railway engineers, possible drawbacks and objections will not be given but the reader will be left to make his own reflections on the question. The available space will be used to give the author's own views on the matter in the form of simple comments on reducing this excess weight, both as regards the materials used and the constructional methods employed, whilst leaving the field open to fresh ideas and new building methods, and expressing these views in a practical manner.

Principles.

The railway has to be restored to its privileged position from the two following points of view, which characterize it as regards present-day requirements : transport, between two centres of large net paying loads; high average speeds.

Men such as TAJANI, for example, in his up-to-date book « Ferrovie » couple this idea — to complete it — to the design of the track and mechanical traction methods, in our opinion two disputable and subsidiary factors. We wish to present the question in considering its present usefulness alone. Other professors add to the above fundamental ideas that of long distances, to the extent these must be taken into account in stating the question. As a matter of fact, this idea is linked up with that of high speeds and one cannot be thought of without the other.

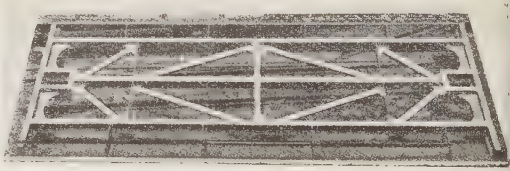


Fig. 1. — Welded frame of 20-ton wagon.

These two conceptions have grown in time as human activities have unfolded, and the evolution has been so great that masses considered large a hundred years ago now seem insignificant, those

(*) See article by the same author on « Dead weight in passenger and goods stock », (translation) published in the Review *Ingeniería y Construcción,* No. 145, January 1935, pp. 9-12.

of fifty years ago small, and those of twenty years ago quite ordinary.

On the other hand, high speeds of 100, 50, or even 20 years ago are ridiculously low when compared with those of to-day. As regards speed we agree with Mr. Dautry (**) who suggests average speeds of 50 km. (31 miles) an hour for secondary lines, and at least 100 km. (62 miles) for main lines.

When we say the railway must be restored to its position as the foremost method of transport this means increasing the tractive power as well as the average speed which in railway parlance is translated into « Light vehicles making up fast trains ». The La Robla Railways which may be considered as main lines in view of their importance, and as mountain railways if the gradients be considered [they are built on

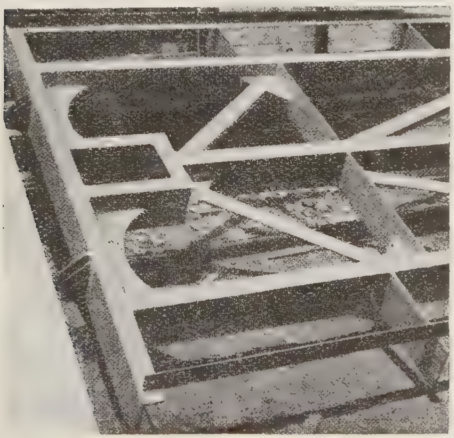


Fig. 1*b*. — End of welded frame; the casing carrying the rubber buffing gear is shown clearly.

the sides of hills at altitudes of 20 to 1 200 m. (66 to 3 940 feet)] form a metre-gauge system. Like all railways throughout the world, they suffer from the heavy tare weights which compels them to use *Garratt* locomotives developing a tractive effort of 18 000 kgr. (39 680 lb.) to haul 260-t. (256 Engl. tons) trains on continuous 1 in 45 gradients.

As will be seen later on these engines, which were able to haul 45 empty wagons with a loading capacity of 10 000 kgr. (9.84 Engl. tons) each (old design), now haul 50 wagons with a capacity of 1 000 t. (984 Engl. tons), as each wagon carries 20 000 kgr. (19.68 Engl. tons). This result has been obtained by removing unnecessary tare or dead weight which reduced the paying load, such as cast iron brake blocks, structural material of unnecessary large dimensions, and of all in short that there was no necessity for the locomotive to haul.

Increase of tractive power with wagons of lower tare and larger capacity.

Originally the tare weight of our goods wagon was only 40 % of the maximum useful load (1890); it increased progressively during the very prosperous period of 1910 to 1920, and reached 65 % in 1926. « Very fine stock » was the comment made when such stock was delivered, and the large dimensions of the wagon parts were admired without reflecting that we were coupling to our old locomotives heavy masses of metal which would adversely affect the timing of the trains, and would help to destroy the equipment by the hammer blows they could give. The fact is that the strength was not only less, but the breakages increased, as also the number of failures, and the repairs were more costly, so much so that by the end of 1926 the error committed and the mistaken course pursued were recognised.

In 1927 we exhibited at the Bilbao Works Exhibition the first arc-welded wagon to be built in the Iberian Peninsula, without a single rivet.

(**) Member of the International Committee patronizing the Journal *L'Allègement dans les Transports*.

This E 44 wagon, whose tare is 30 % of the maximum load, has run 98 000 km. (60 900 miles), and worked 196 000 tkm. (119 870 Engl. ton-miles) without going into shops since it was built. It has undergone the severest tests on this difficult mountain line, and represents the goods wagon as it should be to-day. We have declared war on dead weight; we have taken steps to reduce the tare at first with caution, then more fully, and now the disadvantage of excess tare is realised almost brutally.

In trying to reduce the tare weight we have changed over from the 10-ton wagon to the 20-ton, whilst retaining the 4-wheeled design and still using in the Xf class wagons high sides for goods carried in bulk, and in particular coal.

The Rf class wagons which carry a maximum of 10 tons have a tare weight of 6 1/2 tons or 65 %; the first Xf 20-ton wagon only weighed 6.65 tons empty or 33.25 % of the maximum load. All these wagons are high-sided and run either fully loaded or empty so that the reduction in dead weight is a great advantage. A 33.25 % tare has been obtained (1) by electric welding in conjunction with a more scientific design, and (2) by increasing the load carrying capacity.

As on this railway we are endeavouring not only to run the trains properly but also to get the rolling stock in as perfect order as possible by doing away with the unnecessary dead weight which had been added bit by bit, our investigations are being continued with the object of reducing the 33.25 % still further, by a further long-range shot so as to find out the target somewhere in the bracket, to use a gunner's expression.

The maximum load for a 4-wheeled wagon the track will allow i.e. 13 tons, has already been reached.

As regards design properly speaking and materials, we are progressively reducing the tare to 33, 32, and 31 %, and in the Xf Nos. 38, 39, 40 and 41 wagons, 26.6, 26.5, 26.75 and 24.25 % of the maximum load will be obtained.

The frame of the Xf 38, 39 and 40 wagons, is shown in figures 1 and 1*b*, and is built up of 180 mm. (7 3/32 in.) channels and 80 × 50 mm. (3 5/32 in. × 2 in.) angles.

The tare of wagon Xf 41 has been reduced to 24.25 % by suitably arranging and fastening the three channel longitudinals and cross members; by using the plate into which they are built as the floor, 350 kgr. (820 lb.) has been saved on the wood floor and gusset plates of the old design.

Important weight savings can also be effected in the draw- and buffing gear and by using rubber in the spring gear. The latter consists of rubber pads 20 to 40 mm. (13/16 in. to 1 9/16 in.) thick alternated, according to the load, by steel plates 5 mm. (3/16 in.) thick which keep the rubbers in place (see figs. 2 and 3). These springs before being fitted were tested under loads of 10 tons without loss of height. After running 300 000 km. (186 000 miles), these springs have been taken down, and examined with the following results :

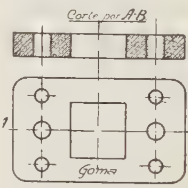


Fig. 2. — Rubber pad used in the draw- and buffing gear and spring gear.

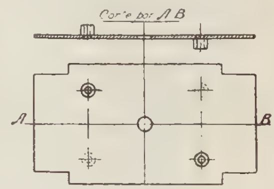


Fig. 3. — Steel dividing plate for the rubber buffer springs.

Note : Corte = section. — Goma = rubber.

1. The draw and buffer springs were definitely a success. Indeed, the heavy forces in play in these trains, which may be 280 m. (919 feet) long on such very difficult lines, are too great for steel springs to stand, whereas the rub-

ber springs have given no trouble. Railway Engineers know only too well what happens when the buffer springs break. The rubber spring is reliable and lightens the anxieties of the wagon repairing staff. The Spencer rings fitted in 1926 have so well protected the six wagons fitted that not one of them has had to be shopped for repairs to the steel members. The rubber pads are giving even better service than the rings.

It is true that in time rubber ages and loses its elastic properties; however, when encased and protected against wet, grease, light and heat it lasts many years and continues to give satisfaction.

2. The rubber bearing springs have run 250 000 km. (155 000 miles) under a load of 6 tons on each. In view of such exceptional results we will refrain from expressing any definite judgment on so important a matter. We feel, however, that the results obtained have been most valuable.

We were not satisfied even with a 24.25 % tare and in consequence built wagons Xf 67 and 68 which are running with tares of 23.75 and 23.5 % of the maximum load.

Class Xf high-sided wagons Nos. 67 and 68 (fig. 4).

These experimental four-wheeled wagons with tares of 4 750 and 4 700 kgr. (10 250 and 10 360 lb.), i.e. 23.75 and 23.5 % of the useful tonnage have not revealed any weakness nor are there any signs that their life will be short. That this would be so is confirmed by the following particulars such as dimensions and weights and descriptions of certain parts.

Xf No. 67 — Figure 4 (first period).

Maximum load .	20 000 kgr.	(44 090 lb.).
Tare	4 750 kgr.	(10 360 lb.).
Loading capacity	20 m³	(215.3 cu. ft.).

Running gear. — Axles with solid steel wheels of 90 kgr. (198.4 lb.); bronze bearings with 84 % tin white metal, welded steel axle boxes.

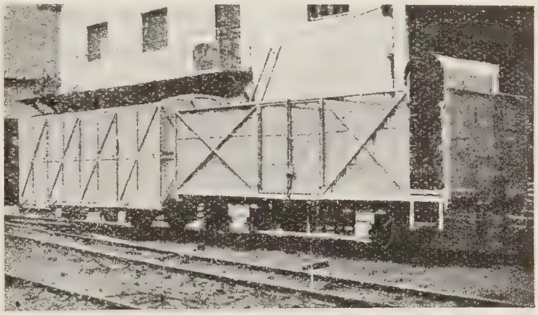


Fig. 4. — Xf wagon with rubber buffers and continuous cable brake.

The total weight of the wheels and axles is 1 680 kgr. (3 704 lb.) which represents quite a saving; we have not gone any further for fear of frightening those railway engineers who are still floundering in the mud of dead weights and, rather than change their views and free themselves, prefer certain death to the risk inherent in any evolution.

Springing. — The rubber springs consist of alternate rings of rubber and steel in guides; total weight 360 kgr. (794 lb.).

Brakes. — Progressive action, 8 blocks, cable-operated (see fig. 5) with brakesman's shelter. The cast iron brake blocks each weigh 22 kgr. (48.5 lb.). The length in contact with the tyre is 310 mm. (1 ft. 3/16 in.).

If the brake is applied with an effort equal to 35 kgr. (77 lb.), the pressure on each block exceeds 1 000 kgr. (2 204 lb.) i.e. more than that required to reach and maintain the maximum braking power necessary when the wagon is loaded.

The particular feature of this brake (Patent No. 138532) is that, when

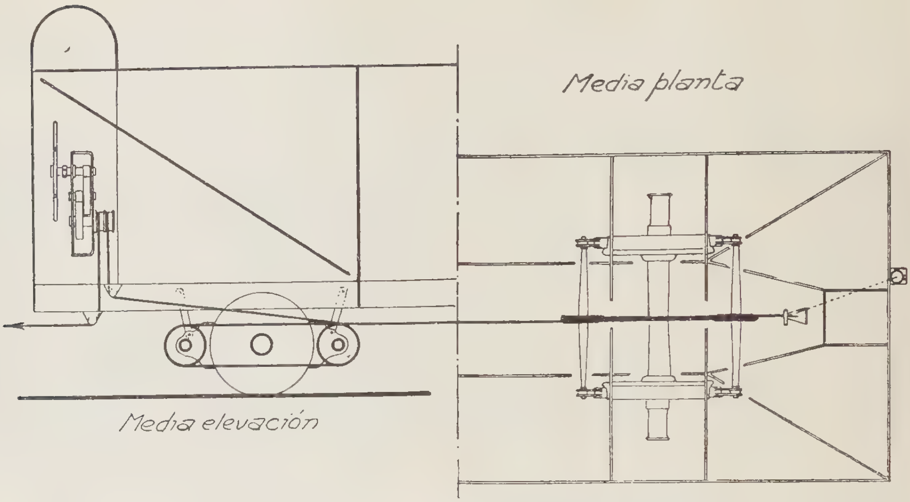


Fig. 5. — Diagram, in elevation and plan, of the continuous cable brake.
Note : Media elevacion = half elevation. — Media planta = half plan.

applied by a brakesman on the wagon fitted with it, the brake power can be transmitted to the two neighbouring wagons by a straightforward wire rope connection.

The working is so simple that if the test results with these two wagons (Nos. Xf 67 and 68) are made use of, the problem of the continuous braking of narrow-gauge trains can be solved This continuous braking will become more and more general throughout the world in spite of the cost and complication of the equipment.

Draw- and buffer gear. — Weight 190 kgr. (419 lb.). Fitted at the centre of the wagon with sections the strength of which exceeds 10 000 kgr. (22 040 lb.); rubber springs; iron safety coupling made of 30 mm. (1 3/16 in.) round bar secured to the headstock by eyes welded to the headstock (fig. 7) instead of to eyebolts through it (fig. 6). The former arrangement has been used successfully since 1927 thanks to arc welding.

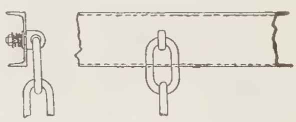


Fig. 6. — Old method of attaching safety chains.

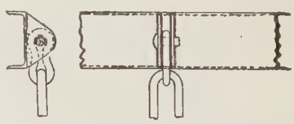
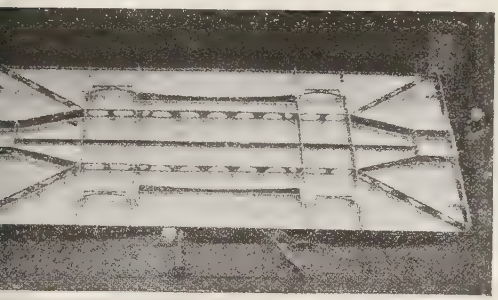


Fig. 7. — Present method of securing safety chains by welding.

Frame (figs. 8 and 8*b*). — Weight 1 650 kgr. (3 640 lb.). No girders. The frame consists of a plain floor plate with two 6 mm. (1/4 in.) thick plate supports connected together on the wagon centre line, the whole is reinforced by ribbed stiffening plates welded to it underneath This represents the transition

from the old design to the box girder design in which the underframe becomes less important, and in fact disappears as in recent passenger coaches.



ig. 8. — Xf wagon No. 67. Floor frame without solebars; tare weight : 10 360 lb.; maximum load : 20 tons; solid wheels — no separate tyres; special 8-block brake — rubber draw- and buffer gear — Tubular reinforced body — galvanised wire sides.

Body. — Weight 450 kgr. (992 lb.). Built up of 50-mm. (2 in.) tubes by arc welding to make the whole body rigid. Wood is still used for the brake shelter

Fig. 8*b*. — End of all-welded floor frame.

(but here too it will be done away with in the near future). Elsewhere wood has been replaced by galvanised wire netting made of 2 mm. (5/64 in.) diameter wire, which has reduced the weight by 450 kgr. (992 lb.). Small coal can be thus carried without loss en route.

Wagon f No. 68 — (fig. 4, second design) :

Maximum load .	20 000 kgr.	(44 090 lb.).
Tare	4 400 kgr.	(9 700 lb.).
Loading capacity	27 m^3	(953.5 cu. ft.).

The running gear, spring gear, draw- and buffer gear, are the same as on the Xf wagon No. 67 described above.

Brakes. — Eight brake blocks per wagon, the brake application being propagated from wagon te wagon by means of a cable.

Besides doing away with the brakesmen and getting a better control of the brakes, as the whole train can be braked on this system from the engine, the stock can be made lighter. *The whole of the brake gear on the Xf No. 68 wagon running on the La Robla Railway only weighs 190 kgr. (419 lb.),* and the brake can be applied with the maximum force even when the wagon is fully loaded to the gauge.

Frame (fig. 9). — Weight 1 690 kgr. (3 725 lb.) formed of two 6-mm. (1/4 in.) thick plate supports connected together to form a sort of ridge beam. The whole is welded and the connections are made of tubes.

Body. — Weight 790 kgr. (1 741 lb.). Built up of angles into a very rigid whole. 8 doors, 4 each side, so that loads of such material as gravel, for instance, can be emptied quickly.

All wood has been replaced by galvanised wire netting made of 2-mm. (5/64 in.) diameter wire.

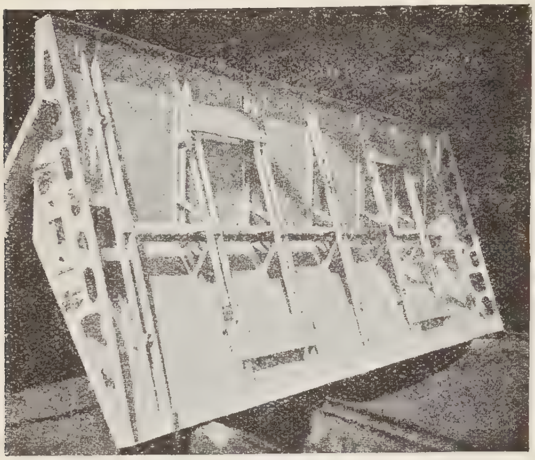


Fig. 9. — Frame carrying the floor, a guide to the future design of a body frame in which the floor carries the load.

Test results and conclusions.

1. The 70 class Xf 20-ton 4-wheeled wagons with 8 brake blocks and solid wheels, built in the railway shops, cost 455 000 pesetas — the first benefit from the weight saving.

2. The average distance run monthly by the whole of the seventy 20-ton wagons with an average tare weight of 5 800 kgr. (12 786 lb.) is 80 000 km. (50 000 miles) in place of the 160 000 km. (100 000 miles) which the 10-ton class Rf wagons with a tare of 6 000 kgr. (13 227 lb.) would have had to run.

The monthly saving effected, therefore, was 500 000 tkm. (305 800 Engl. ton-miles) and the annual output, therefore, would exceed 6 000 000 tkm. (3 669 400 Engl. ton-miles).

We would not like to exaggerate when expressing this in money, but any of our readers in the railway service can multiply the 6 000 000 tkm. by a figure lying between 2 centimos [1] (the minimum cost per tkm.) and 5 [1] (the minimum rate per tkm.).

3. The following additional advantages are also worth mentioning :

The abolition of brakesmen which makes it easier for the operating department to form the trains, without counting the staff and the social questions involved.

Shorter trains mean less air resistance, no reactions throughout the train, shorter length of line occupied, and trains easier to supervise.

Reduction in the ratio of the sprung to unsprung weight — so important for the track.

Conclusions. — The results obtained with the 70 class Xf trial wagons with a gradually decreasing tare (33.25, and latterly 23.5 %, of the maximum load) show that :

1. The tare of metre-gauge goods wagons can and ought to be between 20 and 25 % of the maximum load.

2. Trains ought to be formed of light vehicles of high carrying capacity.

3. When designing wagon bodies, it is necessary to bear in mind the need there is to make them bear their share in the shock-resisting properties of the whole vehicle; this has been done, in the case of passenger carriages, by different Railway Companies such as, for instance, the Union Pacific Railroad in the design of its noteworthy articulated trains.

Finally, as the 23.5 % tare has been obtained using ordinary steel, it may be assumed that in the future new designs may be developed incorporating light alloys (aluminium and magnesium) combined with high tensile steels, such goods wagons being well sprung and incorporating rubber and cork like passenger vehicles.

If such wagons are attached to the proposed Krupp locomotive which will be able to haul 650 tons at 140 km.

(1) 1 centimo equals 1 hundreth of a peseta. At the present rate of exchange 1 peseta is worth 0.4 gold-franc, but its purchasing power is greater in Spain.

(87 miles) an hour, or the most recent Henschel locomotive which can haul on the level 1 500 tons at 90 km. (56 miles) an hour, we may claim to be again right on top of the situation.

We must become more and more convinced of the operating advantages of lighter weights and pay no attention to routine opposition nor seek any personal recompense.

[621. 43 (.44)]

The Dunlop-Fouga railcar with articulated bogies on pneumatic-tyred wheels and elastic wheels,

by G. DELANGHE,
Ingénieur des Arts et Manufactures,
Chef de Travaux à l'École Nationale supérieure de l'Aéronautique (France).

(*Le Génie Civil.*)

The *Génie Civil* has already published several papers on the applications of pneumatic tyres to railway vehicles, in particular to the Michelines, and the Alcyon light motor trolleys (1). Two essential advantages are obtained from these applications :

1. large increase, to the extent of 100 to 300 %, in the adhesion factor as compared with steel-tyred wheels;

2. complete insulation of the body and mechanism from shocks and unpleasant and destructive vibrations due to the track.

Fig. 1. — Dunlop-Fouga railcar with articulated trucks.

These advantages have been proved by experience. In his important article on railcars printed in the *Génie Civil* of the 23rd and 30th November 1935,

(1) See *Génie Civil*, 8th August 1931, p. 111, for the Michelines; 22nd October 1932, p. 397, for the Dunlop rail-road cars; 1st April 1933, for the Alcyon motor trolleys.

Mr. NICOLET, President of the French Main Lines Railcar Committee, stressed the fact that the pneumatic tyre, by acting as a protective mattress between the vehicles and the rail, enabled the vehicles to be built extremely light, and still accelerate at rates previously unknown thanks to the better adhesion.

This lightness does not mean a shorter life and the extra cost of fitting pneumatics is largely made good by the reduction in maintenance costs and the greater comfort. The only disadvantage of the pneumatic tyre is the relatively low weight it can carry owing to the very narrow width of the rail.

We think it will be interesting to give particulars of a new method of using pneumatic tyres in railway work, namely the Dunlop Fouga design, in which the drawback of the low carrying capacity of the tyre has been overcome (figs. 1 to 9).

General description

The Dunlop Fouga railcar carries 50 passengers seated and 10 standing, and 1 000 kgr. (2 200 lb.) of luggage in a central luggage locker. A Maybach 6-cylinder (140 × 180 mm. = 5 1/2″ × 7″) 150-H.P. diesel engine is fitted and the speed is 110 km. (68.4 miles) an hour on the level, and 70 km. (43.5 miles) an hour on 1 in 100 gradients. A speed of 170 km. (105.6 miles) an hour is reached in 70 seconds from starting.

This railcar is composed of three main parts :

1. The running gear, consisting of two trucks, one carrying and one motor, each carried on 4 pairs of wheels. The two middle pairs of wheels of each truck are fitted with pneumatic tyres, and the outer pairs with steel tyres incorporating an elastic member between the tyre and the wheel centre. The pneumatic-tyred wheels on the motor truck are the driven wheels.

2. The body carried by each truck through two laminated springs with silent-block links.

3. The engine with its gear box, batteries, compressor, etc..., is carried on its sub-frame. This sub-frame is carried by the truck through two laminated springs.

The characteristics of the engine have been given above. The 4-speed and reverse S. L. M.-Wintherthur gear box has the gear wheels always in mesh and each speed is selected by its own hydraulically-operated clutch.

We will now deal more fully with the running gear, then with the layout and equipment.

Running gear and articulated trucks. — The Dunlop-Fouga railcar is notable for the particular construction of the frame as a whole and of the running gear, as well as for the way the frame is connected to the mechanism (engine and transmission).

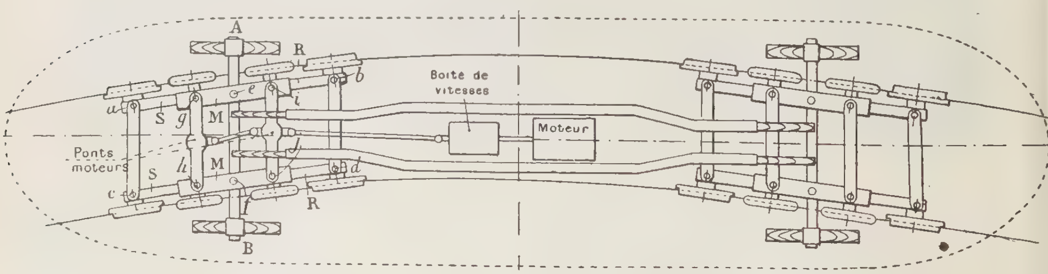


Fig. 2. — Diagram of the frame and running gear of the Dunlop-Fouga railcar.
Note : Boîte de vitesses = speed gear box. — Ponts moteurs = driving axles.

Its most original feature is the design of the trucks, whether carrying or driving, which at first sight might be taken for a bogie but which is in fact very different therefrom. As a matter of fact, the frame of each truck is not rigid but consists of an articulated parallelogram *a, b, c, d* (fig. 2), the longer sides *ab* and *cd* of which can turn on pins at their centre points, *e* and *f*, on a cross bearer AB secured to the body. The cross stays *gh, ij* are also pin-connected to the long sides and remain parallel to the short sides *ac* and *bd*, and therefore do not change their position relatively to the body. The five pins *a, g, e, i, b*, or *c, h, f, j, d* of each solebar are in line.

Each truck has eight wheels which instead of being mounted in pairs on a rigid axle are each carried on its own stub axle rigidly fastened to the corresponding sole bar or the truck. The four middle wheels of the truck are fitted with pneumatic tyres, and the four outer with steel flanged tyres elastically connected to the wheel centres.

In order to distribute the load over both the pneumatic tyred- and the steel-tyred wheels whatever the unevenness of the track, the sole bars *ab* and *cd* each consist of three parts (figs. 2 to 4), a middle bar M and two end pieces R and S.

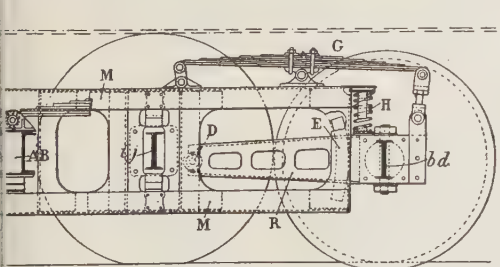


Fig. 3. — Half elevation of a Dunlop-Fouga truck.

The cross bearer AB (fig. 2) projects through an opening cut in the webs of the girder forming the middle bars M. As already mentioned the intermediate cross stays such as *gh* and *ij* are connected (as mentioned above) to the middle bars M by vertical pins inside the brackets carrying the stub axles of the pneumatic tyred wheels.

Each end piece such as R is connected to M by a knuckle joint and moves between parallel vertical guides E. At the free end, the oscillating arm R carries the stub axle F of one of the steel-tyred wheels. The two arms opposite one another on each side of the truck are connected by a stay such as *bd* through pinned joints. The arm R is connected to the middle bar M through two springs in parallel, one a very flexible cantilever laminated spring G, and the other a stiff coiled spring H. The flexibilities of the two springs G and H were chosen so that the variations in the load carried should be suitably distributed between the two types of wheel, to the extent of 2/5 on the pneumatic- and 3/5 on the steel-tyred wheels.

In normal running the arms carrying the steel-tyred wheels only move about 5 mm. (13/64 in.) in the guides. When passing over points and crossings the movement of the body floor relatively to the centre bolster of a truck barely exceeds 6 mm. (1/4 in.).

The load on the pneumatic tyres must alter very little in spite of changes in the total weight of the vehicle. The pneumatic tyres must not be called on to carry more than the maximum limit. When the vehicle is empty, they must still carry enough load to give sufficient adhesion. This latter point is of prime importance for the driving truck, the driving wheels being the pneumatic-tyred ones.

The total flexibility of the two springs providing the elastic connection between the arms R or S, or the middle bars M therefore must not be too great. This is the reason why the coiled springs are of low flexibility; but as the load would come off them completely when the

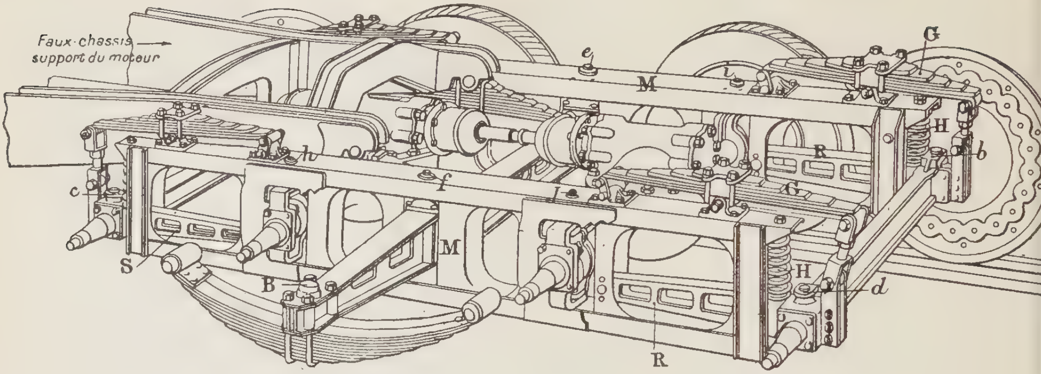


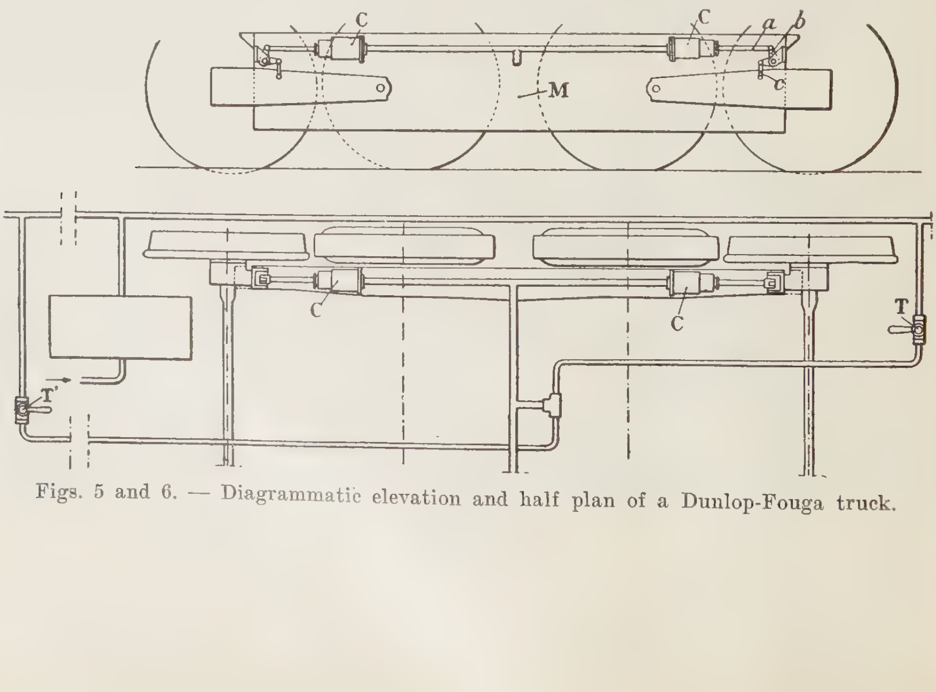
Fig. 4. — Perspective view of a Dunlop-Fouga truck.

Note : Faux châssis... moteur = Sub-frame carrying engine.

wheel is running over a hollow place in the track, the cantilever springs come into action to maintain contact between the wheel and the rail.

The reason for the spherical joint D between a centre bar M and R or S is that the arms are cast steel and very rigid whereas M is a thin pressing rivetted or welded, and therefore more likely to give. The spherical joints D are intended to prevent torsion in the arms R and S when the parts M give on running onto a curve or when some irregularity in the track is encountered.

As it may be necessary, notably when starting, to increase the adhesive weight, the arms R and S can be raised slightly by compressed air. The weight on each pneumatic-tyred wheel can be increased by 300 kgr. (660 lb.) in this way. Compressed-air cylinders C (figs. 5 and 6) carried on the middle bars M of the



Figs. 5 and 6. — Diagrammatic elevation and half plan of a Dunlop-Fouga truck.

truck force the four arms upwards through the gear *a*, *c*, and the rocking lever *b* bearing on the bars M. A spring which tends to restore the pistons to their normal position is fitted in each cylinder. The cylinders are controlled by a 3-way valve T which puts the cylinder into communication with the atmosphere or the compressed-air reservoir; with the valve in the first position the spring gear of the truck is not affected, in the second the load on, and therefore the adhesion of, the pneumatic-tyred wheels is increased.

There are two cocks T and T', one in a compartment at each end of the vehicle, for operating the lifting cylinders C (fig. 6). These two cocks are connected in parallel to the pipe supplying air to the cylinders C through an automatic valve (fig. 7) containing a piston X. When one of the cocks is opened, the compressed air moves the piston and shuts off the other cock.

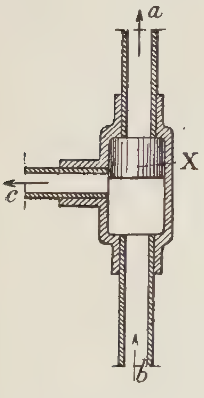


Fig. 7. — Automatic valve controlling feed pipes to lifting cylinders.

a, to cock T;
b, to cock T[1];
c, to lifting cylinders.

The opposing action of the springs in the control gear made it unnecessary to provide any stop to limit the amount of lift. This movement stops as soon as the action of the springs equalises the pressure exerted by the compressed air. As there is no stop, the arm is free to oscillate in the raised position in sympathy with any defects in the track.

As we have already pointed out, only one of the trucks is driven. The driving truck follows the same design as the carrying truck just described, with the difference that the intermediate cross stays are replaced by worm-driven axles on as road motor vehicles. The pneumatic-tyred wheels revolve on hollow stub axles fastened to the solebars. Each wheel is driven through a universal joint where the driving axle is articulated to the solebar.

Both axles are driven through a differential, and in addition each axle has its own differential.

The tyre pressure is 7 kgr./cm^2 (100 lb. per sq. in.), i.e. the pressure in the brake pipe. The tyres, therefore, can be pumped up by taking compressed air from this pipe by means of a flexible connection. If a tyre bursts, the load is transferred to the adjacent steel-tyred wheel as the springs through which the load is transmitted to the wheel in question have to carry the whole weight through the extra deflection. The burst tyre is relieved of all load and the vehicle can work forward to the next station where the wheel can be replaced in a few minutes.

These trucks have several essential advantages : the springing is stable, the vehicle takes curves properly and easily even at high speeds, there is no hunting when running on the straight at high speed, and the driving gear is protected against shocks from the track.

Each truck behaves in fact like the guiding pair of wheels of a motor car automatically steered by the rails. The central bolster acts in fact as an axle body. Each unit made up of a solebar and four wheels pivots about its centre on the central bolster like a guiding wheel, and the hinged cross bars between the solebars act as tie rods. The behaviour of the Dunlop-Fouga truck is entirely different from that of an ordinary bogie. To begin with, the inertia of the truck on entering a curve

is less than that of a bogie, not only because of the lighter weight, but also because the truck on running onto a curve adapts itself to the curve instead of rotating as a whole. Then too, unlike the ordinary pair of wheels, the railcar wheels of the same axle can revolve at different speeds and this eliminates one of the principal causes of hunting.

The following differences between the Bugatti bogie and the Dunlop-Fouga truck are worth mentioning :

The Bugatti bogie (1) (fig. 8) also has four parallel axles E grouped in pairs in

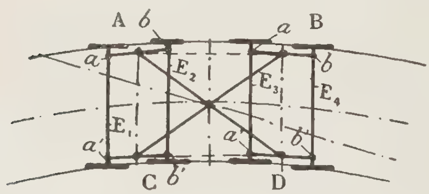


Fig. 8. — Diagram of a Bugatti type bogie.

two identical units. Two axles E_1 and E_2 of one group are connected together by two groups *ab, a' b'* of two parallel superposed laminated springs. The centres A, B, C, D, of the four springs, such as *ab, a'b'*, are rigidly connected by a frame stay carrying at its centre the bogie centre with the pivot pin of the body. Each group of two springs, such as *ab, a'b'*, can turn freely about its centre on the frame stay ABCD whilst at its ends it is connected to the axle bearings through shock absorbers. Consequently the pair of axles such as E_1 E_2 with the corresponding springs *ab, a'b'* forms a parallelogram which can change its form in the horizontal plane.

The body is carried on two longitudinal laminated springs the ends of which slide on the bogie frame. The middle of each spring is connected to the body by a spherical centre to allow for any movement of the centre part of the bogie relatively to the body.

Each half of the Bugatti bogie, therefore, forms a deformable parallelogram, but as the wheels are keyed directly to the axles their position relatively to the track is controlled by the transverse position of the axles; in the Dunlop-Fouga truck, on the other hand, the orientation of the wheels is controlled by the position of the two solebars according to the chord of the mean curve of the track.

(1) The P.L.M. Bugatti railcar was described in the *Génie Civil* of the 7th Juli 1934, p. 18. See also *Bulletin of the Railway Congress*, September 1934, p. 993.

Body construction, decoration, and equipment.

Body frame. — The body frame is built up entirely of rolled sections electrically welded (fig. 9). It forms a girder which is fastened to the pressed steel body floor. Openings are provided in each end of the underframe for lifting bars when the body has to be lifted for repairs. So as to give the passengers an uninterrupted view to the front or to the rear, the luggage compartment is arranged in the middle of the vehicle.

Heating and ventilation. — Hot water from the engine is circulated through radiators under the seats. Electric fans drive air through the radiators thereby diffusing the heat throughout the car. Thermostats control the fans by switching them into or out of circuit according to the temperature in the body.

The circulation of the ventilating air in the body is regulated by openings and inlets in various positions.

The engine cooling water used in winter to heat the vehicle as described above is cooled by means of a Lamblin radiator. As the radiator is carried on the roof, there is no danger of it being struck by stones and it is cooled equally well in both running directions.

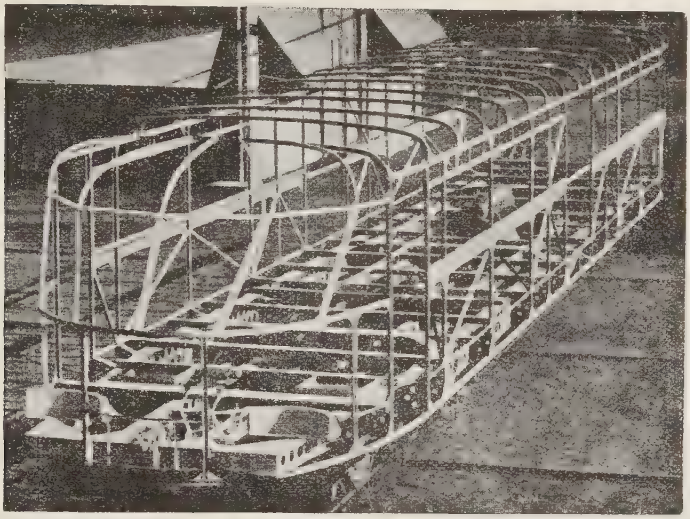


Fig. 9. — Body framing of a Dunlop-Fouga railcar.

The raised position also removes any danger of its freezing up. When the engine is stopped the circulating water fills the pipes up to the top of a supply tank in the engine room, the tank having a ventilating pipe open to the atmosphere. When the engine is running the circulating pump draws about half the water from this tank and forces it through the radiator. As soon as the engine stops the radiator empties and the water refills the supply tank.

Driving compartment and distant control. — The Dunlop-Fouga railcar has a driving compartment at each end. Hydraulic control gear is used owing to its convenience. Each control lever displaces a rack with two pistons moving in two opposing cylinders. These cylinders are connected to two cylinders of the same size, the piston in which displaces a rack which in turn moves the distant-control levers. The whole circuit is filled with a non-freezing liquid and provision is made for neutralising the expansion of the liquid through heat. Indicator lamps are provided to show the driver that the distant-operated gear has taken up the desired position.

There are three levers in each driving compartment, one for starting and speed changing gear, the second for controlling the engine power, and the third for the reverse gear. The brake is controlled by two pedals which are pushed down, either together or separately, depending on the circumstances. The first brakes the pneumatic-tyred wheels and the second the steel-tyred wheels.

The hand-operated sanders are used when braking and the pedal-operated sanders when starting. A telephonic sounding device is fitted to enable the driver to sound the engine from the driving compartment. A bank of indicating instruments is arranged before him to enable him to watch the running of the vehicle and the working of the principal parts.

Brakes. — Lockheed oil-pneumatic brakes are fitted acting on brake drums fastened to the wheels. There are two

independent circuits, one braking the steel-tyred wheels, and the other the pneumatic-tyred wheels; the latter is the emergency brake.

Each circuit is controlled by a pedal; both brakes can be applied simultaneously. A hand brake is provided as a standby. It acts on the driving shaft between the gear box and the driving axles.

Buffing and draw gear. — The buffing gear at each end of the vehicle consists of the tyres of two spare wheels carried on moveable cradles, located the same distance apart and at the same height as ordinary buffers.

Drawhooks concealed in the body, one at each end, can be brought into use by lifting up a trap. A special coupling bar included in the equipment carried on the car can be used in case of accident to couple the railcar to an ordinary type of hook. The compressed air pipes of the railcar can also be coupled to those of any locomotive used to haul it.

As the Dunlop-Fouga railcar has steel-tyred wheels, the vehicle running over the lines short circuits the track circuits which it would not if all the wheels had pneumatic tyres.

[625. 234 (.44)]

Paris Orléans-Midi system of air-conditioning for railway carriages,

by M. LEBOUCHER,

Ingénieur en chef honoraire des Etudes du Matériel et de la Traction.

(Revue Générale des Chemins de fer.)

Air conditioning of railway carriages and especially their heating is a question to which the French railways have given much thought. The Paris Orléans-Midi Railways, as a result of the progressive electrification of their lines have had to study the question in all its aspects and have introduced a new practical and economical system which marks real progress in travelling comfort.

By fitting direct electric heating the difficulties due to the use of two methods of traction, steam and electric, had already been reduced. But whether the heating was by steam or electricity, the vehicles were not scientifically ventilated, although improved ventilation was more especially necessary during the heating season as the old methods of changing the air could no longer be resorted to.

The air in the compartments in winter became unpleasant to breathe and often very hot.

The gradual demand for improved comfort resulted in the users making criticisms which had to be taken into account. The railway on its side followed with great interest the progress being made by heating and ventilating specialists.

Further defects in the systems in use were brought to notice at the time we realised a new design for heating the carriages was required.

The introduction of two heating systems (steam and electric), so that the carriages could be heated under any operating conditions, involved fitting each carriage with two sets of heating equipment — one electric and the other steam. This made the equipment very complicated, especially in international

traffic when the electric heating had to work on 1 000 and 1 500-volt current and possibly 3 000 in the future. Moreover, the cost of such equipment is high and its efficiency low.

Finally the calorific inertia of the devices used made for irregular heating due to the wide variations in temperature in the compartments when changing from one system to the other.

The system designed and perfected by the Paris Orleans-Midi Railways, in conjunction with the « Compagnie Auxiliaire d'Entreprises Electro-mécaniques » and Messrs. « Freins Jourdain-Monneret », completely solved the problem and satisfies the following conditions :

1. quick and economical heating of the compartments;
2. constant temperature in the compartments :
3. continuous and controlled renewal of air in the compartments;
4. suppression of sudden heat waves;
5. adaptability to all international services without serious alteration in the stock;
6. cheapest first cost.

The system can be completed by air cooling plant as fitted on some of the carriages since air conditioning was first considered.

When the two systems are fitted, complete air conditioning is obtained without complication nor cost, and adapted to European conditions.

Various observations made have shown that the lack of comfort through defective compartment heating is due to the following chief causes :

1. the loss of heat through the floor is not made good by the radiators and the hot air accumulates in the top of the compartment;

2. the steam and electric radiators in the compartments heat by convection and their efficient working is consequently interfered with by being placed under the seats. Owing to their size and shape, the seats hold back the air heated by contact with the radiators, which air becomes overheated and only escapes in waves;

3. the heaters can be fitted in certain places only; they heat the walls around them before really helping to warm the compartments and this makes it necessary to preheat the vehicle over a prolonged period.

The diagram hereafter shows the working of the heating equipment we designed to overcome the above drawbacks.

The fresh air drawn in by a silent fan under the frame is filtered and then forced into the distribution duct through a heater where its temperature is raised to the desired extent. The insulated distribution duct is brought up through the floor in the middle compartment where it divides into two branches one going to each end of the coach.

The two branch ducts — also insulated — run along the body side at floor level, and carry in each compartment two diffusers located under the seats. Five compartments are moreover fitted with a secondary duct which is carried under one of the seats to a diffuser in the corridor partition and warms the corridor.

The air blown into the compartments expands freely under the seats whence it rises at once but slowly and uniformly throughout the compartment to escape finally by an exhauster in the roof.

The air is diffused through the corridor in the same way but no exhauster is fitted, the air getting away through interstices of the doors, vestibules and bellows.

As the speed of the air leaving the diffusers is only a few centimetres a second, dust on the floor is not disturbed.

Thanks to this arrangement and the constant renewal of the air, the latter

wholly surrounds the passengers, and a comfortable temperature is maintained about the passengers' legs and the radiation of the floor is made good; the warm air cannot remain trapped under the seats nor in the top of the compartment and is moreover circulated in such a way that the temperature in the whole of the compartment is practically constant without the passengers being conscious of any air movement.

Then too, after preheating only a very short time, the cold atmosphere of the compartments becomes pleasantly warm and gives the sensation only obtained with other systems after prolonged preheating.

The fan is set to give 100 m³ (3 530 cu. ft.) of air per compartment, equal to 10 renewals an hour or 16 m³ (565 cu. ft.) of fresh air per passenger.

The application of such a system conduces to the adoption of automatic temperature control (pneumatic- or electrically controlled thermostats).

As a matter of fact, automatic temperature control in railway carriages is interesting as regards power consumption, whether electric or steam. The following examples illustrate this point.

A night train running between Bordeaux and Sète with an outside temperature of 9° C. (48.2° F.) was maintained at a constant temperature of 18° C. (64.4° F.), although the heating was only really working 10 minutes. This shows the steam saving as compared with the steam being on all the time (*).

Besides, thermostatically-controlled air conditioning is much cheaper as regards the installation itself than separate electric and steam heating, as there is only one set of heaters using steam or electricity and only one set of supply ducts is required.

(*) In this case the coach was fitted with ordinary thermostatically-controlled steam heaters and not heated by pulsated air.

In the Paris Orléans-Midi coach the temperature is automatically regulated by two pneumatic thermostats in the two check compartments and set to cut in and out as the temperature drops or rises about the determined limits.

The tests show a variation of temperature not exceeding 1.5° C. (2.7° F.), such a result being due to the low calorific inertia of the system.

An ice tank is fitted at one end for cooling the air. A second silent fan draws fresh air from outside through a filter and the cooler and distributes it to the compartments through a lagged duct between the roof and lining of the corridor.

The fresh air is diffused into the compartment through a diffuser at the top of the corridor partition, so arranged that the air is amply directed towards the floor as shown in the diagram.

The used air is then exhausted through a static exhauster in the roof so that the fresh and cooled air is supplied as it should be throughout the top part of the compartment and any accumulation of warm air in the zone the passengers breathe in is prevented.

Automatic temperature regulation is not used in connection with simple ventilation nor cooling. The methods used to regulate the air passing over the cooler are chosen to prevent a difference of over 5° C. (9° F.) between the inside of the compartment and the outside atmosphere, so that the passengers run no risk of a chill.

This system of air conditioning, and especially the heating system, would very easily allow, thanks to the arrangement adopted, of the heating power being automatically adjusted to the outside temperature variations, so as to control more accurately the inside temperature, especially between extreme seasons; however, our aim has been to evolve a system as complete as possible, but which remains simple, and is easily

Heating a compartment. **Heating the corridor.** **Cooling the compartments.**

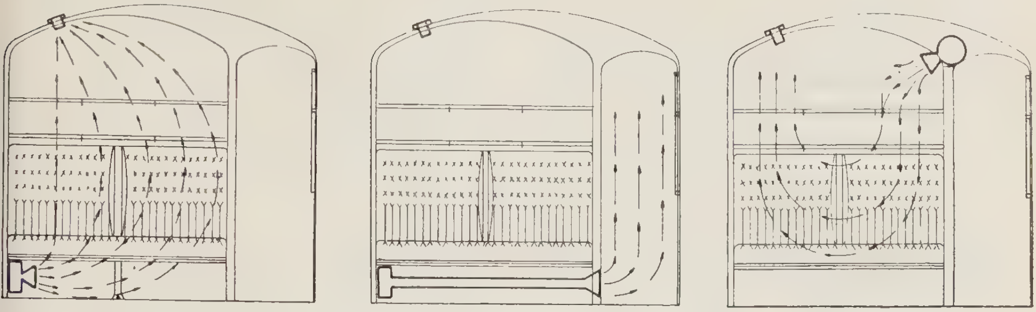
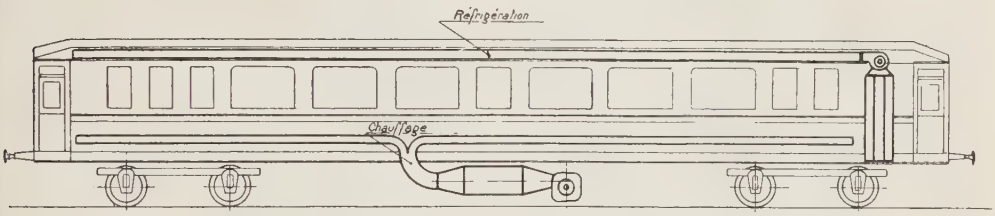


Diagram showing the distribution of the air.



Note : Réfrigération = cooling. — Chauffage = heating.

and cheaply maintained, without seeking for precision higher than the normal utilisation of the carriages will permit. Such precision can only be obtained at the cost of a serious complication of the apparatus, the good features of which are partly nullified by the practical conditions of use (passengers moving in the trains running long distances, doors being opened, etc.).

As regards the utilisation of the heating system by pulsed hot air on electric lines fed at different voltages, the following arrangements have been adopted.

The electric heating gear has heating elements which can be coupled :

— in parallel, when the supply is 1 000-volt A. C.

— in series parallel, when 1 500-volt D. C., and

— in series, when 3 000-volt D. C.

This is done automatically, the gear being housed in a single casing under the coach, including :

Voltage selector relays operating as soon as the electric heating circuit is under load and causing the coupling, under no load, of the heater elements as well as throwing into circuit the protection fuses corresponding to the line voltage;

Coupling contactors controlled by selecter relays with automatic mechanical and electro-magnetic safety interlocking so that the heating equipment cannot be brought into use when for any reason the connections are incorrect or badly made;

A main contactor controlling the heating installation, and working normally under the different voltages given above, and meeting the following conditions :

1. cannot be closed unless the couplings correspond to the working voltage;

2. the circuit is broken if by accident the normal coupling is badly made;

3. when closed all the couplings are mechanically locked and the current is

cut off for economy from their interlocking windings;

An automatic fan starting device operated by the main contactor, so as to make the working of the fan depend on that of the electric heater.

Various safety devices provided to :

— protect the heater if the fan stops or there is prolonged overheating;

— protect the accumulators against excessive discharge, the control circuits of the heaters and ventilating fan working on 24 volts off the lighting plant.

A hand-operated switch accessible from inside the carriage is used if necessary, whatever the method of heating used or the line voltage, to :

— cut off the heating;

— cut in the automatically regulated heating;

— heat without automatic regulation.

The tests of this heating equipment were made, in 1935, at the same time as other tests of equipment fitted to Swiss, Italian, German and Austrian coaches carried out by the 5th Commission of the International Railway Union (U. I. C.) under the following voltages :

Italy : Bologna to Florence, 3 000-volt D. C.

France : Chambéry to Modane, 1 500-volt D. C.

Switzerland : Chaux-de-Fonds to Berne, 1 000-volt D. C.

The satisfactory results obtained during these tests proved the accuracy of the hypotheses on which this equipment was designed; they also demonstrated the reliability of all parts of the automatic equipment, which, in the case of through international traffic, provides the most complete solution of the problem consisting in comfortably heating carriages without any complicated operations in transit stations.

[621. 133. 2 & 669]

Specifications for locomotive firebox copper,

by M CHAN,

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(Revue Générale des Chemins de fer.)

Until quite recently copper was considered in Europe the most suitable material for locomotive fireboxes. Although steel, following the general American practice, is being introduced on some of our railways, copper is still very widely used. This metal is a very good conductor of heat. For equal strength the copper tube plate has to be about twice as thick as a steel one (30 mm. = 1 3/16 in. instead of 13 mm. = 33/64 in.) and the other firebox plates 14 mm. = 35/64 in. instead of 8 mm. = 5/16 in.). The coefficient of heat transmission being 0.93 for copper and 0.14 for steel more than makes good this drawback. Moreover, copper is easily worked and is less sensitive to heat variations. Finally it does not oxidise and gives longer life.

This does not mean that copper has no disadvantages. Apart from its price being 3 or 4 times that of steel, cracks and deformations occur and the stays do not stand up as well as might be expected. The wear of stays is one of the principal defects and has become more marked in the boxes of our modern and more heavily worked locomotives, and railways are much concerned by it.

The object of the present note is to show that these defects are due to the very nature of red copper, and to show the improvement to be made by thoroughly studying the effects of impurities and, as has been done in the case of steel, by using special coppers containing small quantites of other elements such as silicon, nickel, cobalt, silver, etc...

The question is so important as regards firebox maintenance and the possible savings so great, that we propose to deal with the matter in some detail and hope the article will not be found too dry.

Defects found in service.

A. — *Wear of stays.* — The stays connect the two sides of the waterlegs and prevent them from separating under the steam pressure. The heads located on the fire side wear quickly, especially in the area under the back end of the arch. On certain heavily worked 4-6-2 G locomotives with manganese-copper stays, 400 to 600 have to be renewed after running some 70 000 km. (43 500 miles). The position can be improved by fitting red-copper stays, but the wear will still be rapid and there may be breakages.

Such wear is due undoubtedly to a large extent to the leakage of water or steam between the stays and plates. In a dry atmosphere the wear could only be due to the combined action of abrasion and oxidisation; it would not be uniform with any particular stay head, nor would it extend, as is found frequently, around the head.

As a proof of the preponderating influence of leakage we would quote :

— Rapid wear of *headless* stays tried experimentally by the Paris-Lyon-Méditerranée Railway some years ago. The metal disappeared progressively until the end of the stay was inside the fire side of the plate (fig. 1) although the stays were in a zone where abrasion and direct contact with the flame was not great.

— The improvement obtained by *welding* the heads and thereby entirely preventing leakage (see fig. 2).

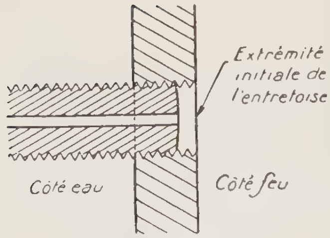


Fig. 1.

Note : Côté eau = water side. = Côté feu — fire side. — Extrémité initiale de l'entretoise = end of stay as fitted.

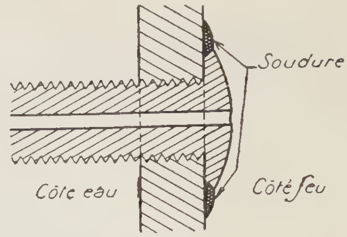


Fig. 2.

Note : Soudure = weld.

This method has been in use on the Paris-Lyon-Mediterranée Railways in connection with steel stays since 1933, and is now used by the Reichsbahn in the case of copper stays. It may be said by the way that welding copper stays is a costly and delicate job, and that the use of special copper alloys, as we will point out later, appears to be a better method. We deemed it interesting, however, to mention these tests as showing that leakage is the origin of wear.

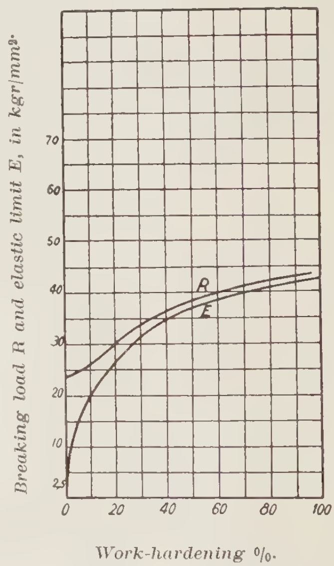
The leakage is greatest when the boiler is cooling down, i. e. when the pressure is low and does not keep the threads in contact; traces of water or « weeping » above the heads is then visible.

As this leakage occurs on our modern engines even when the stays are very accurately fitted, it must be admitted that play occurs in service between the threads. Play is in fact set up and is due, as will be shown, to the very low elastic limit of annealed copper.

Being subjected to the different expansions of the steel casing and of the copper box, and to the boiler pressure, the threads of the stay and plate tend to deform each other, and if the stress exceeds the elastic limit, the thread becomes permanently deformed.

Now, the elastic limit of red copper is so low as to be hardly measurable, so that the above deformation may be expected to occur the first time the boiler is lighted up.

The deformation continues until the copper, under successive movements, becomes work-hardened with a sufficiently high elastic limit to balance the forces. Figure 3 shows the relationship between



(The degree of work-hardening is measured by the reduction of section relatively to the original.)

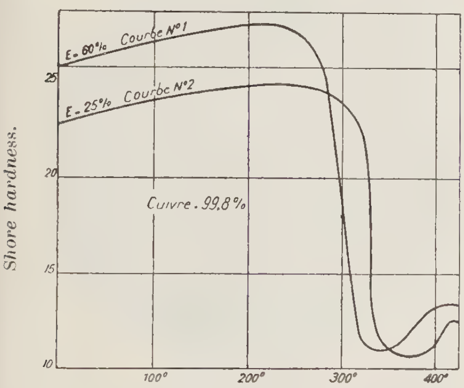
Fig. 3.

the degree of work-hardening and the elastic limit (1). It will be noticed that whilst work-hardening has little effect

(1) Curve reproduced from article by Mr. KRUPKOWSKI in the *Revue de Métallurgie*, Oct. 1931, p. 544.

on the breaking strength, it has a marked effect on the elastic limit. It will be appreciated, therefore, that a very slight deformation is sufficient in the ordinary case of lightly worked locomotives, to give, with the initial work-hardening when forming the head (1) sufficient elasticity, and that in spite of the above theory is has been possible to obtain suitable tightness.

This is not the case with modern heavily worked locomotives, because the phenomenon is further complicated by the higher firebox temperature of 300 to 350° C. (572 to 662° F.) at the lower part of the firebox plates. At this temperature, work-hardened copper becomes self-annealing as shown in figure 4 (2). *The*



Curves showing the loss of hardness by recrystallisation under the effect of heat. Curve No. 1 is for a copper cold work-hardened to 60 %. No. 2 curve applies to 25 % work-hardened copper.

Fig. 4.

metal consequently becomes annealed automatically as it becomes work-hardened. Further self-hardening is therefore out of the question nor can the copper reach any higher elastic limit. The deformation of the thread and the head (as the work-hardening done in forming the head also disappears) continues, it may be said, uninterruptedly, though at a very slow rate. This is, it would seem, the cause of the extremely rapid wear of the heads on heavily worked engines. It is due in fact to the *fireboxes now working at temperatures round about 300° C. (572° F.) at which the properties of copper change.*

Firebox temperatures. — In this connection, the measurements made by the English railways (see *Journal of the Institute of Metals,* 1929, Vol. XLII, p. 222) should be noted. These tests, which it appears are very difficult to make with thermo-electric couples, were carried out by using fusible plugs of ternary alloys inserted inside the plate. The temperatures were found to be 300 to 350° C. (572 to 662° F.) under the arch, and 200 to 250° C. (392 to 482° F.) in the upper stays on the sides. No temperature over 350° C. (662° F.) was recorded.

We can conclude from the above that *the stays would stand up much better if the firebox copper plates could retain an appreciable elastic limit at 350° C. (662° F.).* This also applies to the stay metal, as the leakage is due to the mutal deformation of the two assembled parts.

B. — *Bulging of firebox sides.* — This bulging occurs between the stays and is found in the lower part of locomotive fireboxes in which plates reach the high temperatures just mentioned and in particular on the Paris-Lyon-Méditerranée Railways' 2-10-2 locomotives, with 20-kgr. (284 lb. per sq. in.) boiler pressure.

This bulging appears to be due to the same cause as the leakage at the stays. It takes place slowly but continuously through the annealed copper having no elastic limit and not becoming work-hardened owing to the temperature.

(1) Certain railways increased the work-hardening by drifting. Accidental work-hardening of this kind chanced to give the copper the high elastic limit needed.

(2) Curve reproduced from the *Revue de Métallurgie,* December 1928, p. 692.

C. — *Leakages of tubes at the tube plate.* — The reason is the same, present-day temperatures preventing work-hardening of the tube plates.

D. — *Cracks.* — As is known, this damage is found as a rule in the rounded-off parts or edges of the copper tube plates. It is also found on some Paris-Lyon-Méditerranée boilers in the radii of the firebox crown with the tube and back plates.

These cracks are due to mechanical forces and to bending. They can be reduced by better firebox design but the quality of the copper also plays a part.

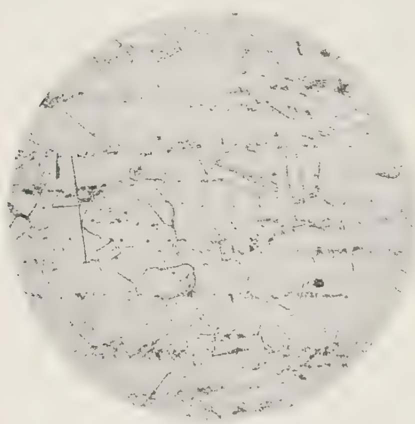
When the damaged part is examined under the microscope the appearance of the metal is different from that of a new fracture.

The new metal (fig. 5) has a fine grain and the copper oxide drawn out by rolling is inside the crystals.

The defective metal (fig. 6 is characteristic) has a coarser grain (1), and the copper oxide is collected with the eutectic round the crystals of pure copper.

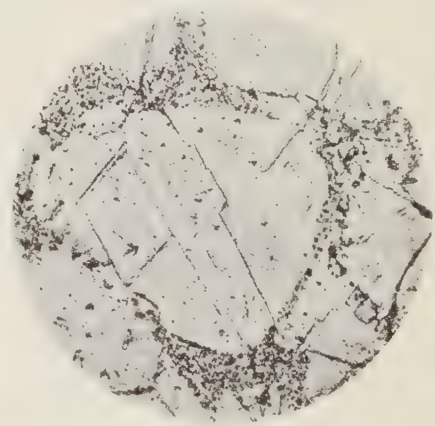
With new copper, the ends of the test piece can be bent until they come together but with the old copper 90° is sometimes the most they will bend.

This is the result of recrystallisation or ageing. This change occurs in all metal when certain temperatures and work-hardening conditions are fulfilled. The interesting thing in the case is that the conditions required for ordinary copper are present in the boiler itself,



New copper.

Fig. 5 (Magn. : 75 diam.).



Copper crystallised in service (taken out of 4-6-2 locomotive D 225 after 127 730 km. (79 370 miles).

Fig. 6. (Magn. : 75 diam.).

viz : the temperature in the upper part of the plates — 250° C. (482° F.) — and the degree of work-hardening produced by the fatigue of the metal in the rounded-off parts and at the joints (1).

As a matter of information, figure 7 shows the aspect a work-hardened copper at one part of which recrystallisation has been quickly brought about by raising its temperature sufficiently by means of the blow-pipe, as a high temperature accelerates the process.

The metal shown is new to the left and is commencing to recrystallise on the right.

(1) The grain is coarser at the edge than in the interior, the metal adjacent to the neutral axis being less work-hardened by the bending of the metal.

(1) It may appear astonishing to see that the copper, which only crystallises at 300° C. (572° F.) as we saw in connection with the stays at the bottom of the box, here crystallises at 250° C. (482° F.) in the top of the box. This is because the metal in the rounded-off parts and at the joints suffers from fatigue much more than in the stays. Hence there is much higher local work-hardening at these points with a corresponding lowering of the recrystallisation temperature.

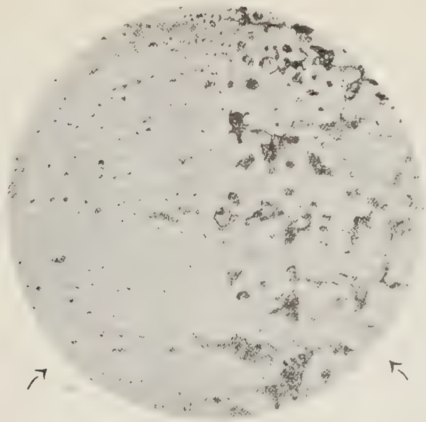


Fig. 7.

As crystallisation directly affects the mechanical properties of the copper there is every reason why it should be tried to prevent it. As we shall see later, this is possible by acting upon its composition.

Remarks on the copper oxide. — The cracks in copper plates are explained sometimes as due to a chemical decomposition of the oxide $Cu^2 0$ by the reducing gases in the firebox according to the formula :

$$Cu^2O + 2H = 2\ Cu + H^2O.$$

In this classic reaction the steam vapour formed as it were expands and cracks the metal.

From our observations on the Paris-Lyon-Méditerranée engines, this cannot be the cause in locomotive boilers.

Under the microscope the cracks have the same appearance on both the fire side and the water side, although the latter is not affected by the firebox gases. Actually these gases are hardly reducing, except possibly when firing. The atmosphere is as a rule oxidising and according to the English tests highly so in the top of the box (see article in the *Journal of the Institute of Metals,* quoted above).

Moreover should the oxide play the part this theory suggests, its presence should reduce the life of the plates and those with the highest percentage should have the shortest life. This is not so, however. As an example, the same type of crack was found on the Paris-Lyon-Méditerranée 2-8-2 C-404 engine after running 267 000 km. (165 900 miles), on the 2-8-2 C-101 after 417 000 km. (259 100 miles), and on the 4-6-2 D-91 after 735 000 km. (456 700 miles), the first containing 0.08 % of oxygen, the second 0.16 %, and the last 0.14 %. Of course we do not wish to minimise the importance of a low oxygen content but its limit should no be determined solely by itself, but in relation to the other elements present according to the principles outlined below and with regard to its influence on the crystallisation.

Qualities to be specified for copper.

We can summarise the above remarks as follows :

— If copper could be made to retain an appreciable elastic limit at 300 to 350° C. (572 to 662° F.) leakage would be prevented.

— If copper retained its structure without crystallising at temperatures below 300° C. and after being work-hardened, the cracks would develop much more slowly.

We will examine separately the methods of producing these qualities,

though we must not be surprised if the conclusions in the two cases are the same, as retaining an elastic limit at temperature and starting crystallisation under heat are related phenomena.

A. — *Retention of an appreciable elastic limit at 350° C.* — a) *A high elastic limit* can be obtained primarily *by simple work-hardening* (original work-hardening or self-hardening in service), but, this hardening must not disappear in service as we have seen happens with ordinary copper. This leads to the addition to the copper of small quantities of various elements, such as nickel, lead, silver, etc., the effect of which is to raise the temperature at which the work-hardening is removed, namely the annealing or recrystallisation temperature.

From tests made abroad :

Higly hardened ordinary copper anneals at 200° C. (392° F.) ;

0.28 % nickel copper anneals at 250° C. (482° F.) ;

0.15 % lead copper anneals at 325° C. (617° F.) ;

0.24 % silver copper anneals at 340° C. (644° F.).

Certain elements allowed today as impurities lower the temperature : 0.21 % of iron, for example, reduces the temperature from 220° C. (392° F.) to 190° C. (374° F.). Moreover, the elements also act differently according as they are alone or in the presence of others. Oxygen appears to be less harmful in the presence of arsenic. This shows how important it is to limit the content of each impurity instead of lumping them all together at a maximum of 0.4 % as in the present French standard specification No. 15.

We need not go in detail into the various compositions suggested. The producers have it in their power to considerably improve copper and *raise the crystallisation temperature after work-hardening to over 350° C. (662° F.).*

To see what results are obtained, practical tests should be made which should reproduce as far as possible firebox conditions. *Hardness, bending and resilience test pieces would have to be kept at a temperature of 350° C. (662° F.) under at least 4 kgr./mm² (2.54 Engl. tons per sq. in.) tension for a long time (500 hours for instance), and then subjected to the corresponding mechanical tests. The results obtained ought then to be little different from those given by new metal neither heated nor work-hardened.*

b) Something even better is possible. Instead of being content with the elastic limit due to work-hardening, an endeavour should be made to obtain a *high elastic limit by heat treatment.* M. Corson gave particulars of such researches in a long article in the February 1930 number of the *Revue de Métallurgie* to which we would refer readers. Guided by theoretical considerations, the author endeavoured to introduce into copper very hard elements which by deposition between the grains of the metal during annealing prevented intercrystalline slip.

The best results were given by the combinations : (*a*) silicon and cobalt (cobalt silicate is very hard), and (*b*) silicon and nickel. The author suggests for firebox plates, copper containing 4 % of Ni^2Si (page 277, May 1930 number of the *Revue de Métallurgie*).

As a matter of information, let us mention that tests are at present being carried out in Germany on alloy plates known as « Kuprodur », containing 0.7 % of nickel and 0.5 % of silicon, the elasticity of which is obtained by heat treatment and is retained up to 400° C. (752° F.). Stone's metal known as « Stone elastic » comes under the same category.

It should be noted that some of the special coppers hardened by heat treatment have only some 20 % elongation which is less than that of ordinary red copper, viz. 35 %. As the top parts of a firebox have to stand a good deal of cold work, this class of metal is not suitable for such use. It can be used without objection in the hottest zone of the box where the surfaces are plane and where the improvement in the copper is most needed, and also for the stays.

With the heat-treated copper just mentioned the best test to prove the quality in our opinion is a long-period tensile test at 350° C. (662° F.) giving a limit of proportionality of the order of 8 to 10 kgr./mm² (5.1 to 6.3 Engl. tons per sq. in.).

B. — *Methods of preventing crystallisation at 300° C. (572° F.).* — Crystallisation at 300° C. *(572° F.)* of a work-hardened copper can be prevented as we said under (*a*) above, by increasing the recrystallisation temperature by adding some element such as lead, silicon, silver, etc...

On the other hand, if special copper with a high elastic limit obtained by heat treatment be used as in (*b*) the copper will not work-harden nor crystallise.

The two solutions proposed in the preceding paragraph consequently also meet these conditions and as the temperature considered in the said paragraph was 350° C. (662° F.) copper meeting the requirements given therein will a fortiori meet those of the present case.

Nothing further need be added to what was said above.

Conclusions.

Copper to the Standard French Specification No. 15 does not retain the necessary mechanical properties in modern fireboxes.

At the temperatures in these boxes (300 to 350° C. = 572 to 662° F.), any properties as regards its elastic limit which it could formerly obtain from work-hardening disappear. The metal, moreover, crystallises and ages. The consequences as we have explained at length are leaky tubes and stays, deformation of the plates, and cracks.

These defects can be cured by careful selection of the elements associated with copper, either as impurities or as additions. The impurities allowed in the specifications (up to 0.4 % in Specification No. 15) have considerable influence depending upon the exact content of each and their reaction with one another (Let us say by the way that the production of very pure copper would be a step to oppose this objective) (1).

A first improvement can be effected by studying these impurities. The most marked and effective improvement, however, is to be obtained by systematically adding elements such as silicon, nickel, cobalt, and silver (2) or others.

We do not pretend to solve the problem, which is a metallurgical one and has been in fact already partially solved by certain metallurgists. We only wish to indicate the object aimed at and to show in each case the test which in our opinion should serve as a critirion.

We have indicated two possible solutions :

— one consisting simply in raising the crystallisation temperature of work-hardened copper above 350° C. (662° F);

the other, giving the copper, by heat treatment, a higher elastic limit persisting beyond 350° C.

The first, which is the cheapest and can be obtained with copper only differing from ordinary metal by the addition of a single new element might be generally used for firebox plates and stays.

The second, which is more costly and requires a more complex composition could be retained for the lower parts of the inner firebox sides, for the stays in this part of the box, and for bushing holes in the tube plates.

In spite of the dryness of the subject, we felt it should be dealt with at some length because the railways are finding expenditure on their boiler repairs heavier and industry appears to be able to supply copper which would overcome to a large extent the defects experienced, which would assist the designer in getting out the best type of firebox.

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(1) It appears that investigations into the effect of each impurity could be facilitated by using electrolytic copper, as the contents can then be changed more easily.

(2) From information supplied by M. Bancelin, Chief Engineer of the French State Railways' Laboratory, arsenic also has the property of retaining the elastic limit of the work-hardened metal when hot.

MISCELLANEOUS INFORMATION.

[625. 23 (.43)]

Streamlined articulated double-decker trains on the Lübeck-Büchen Railway,

by Herr MAUCK, Ing., V.D.I., Mechanical Engineer, Lübeck-Büchen Railway, Lübeck, Germany.

(From *L'Allègement dans les transports*).

The Lübeck-Büchen Railway Company carried out trials with its new streamlined trains (figs. 1 and 2) on the 7th April 1936. These trains were ordered for the interurban service between Hamburg, Lübeck and Travemünde and the suburban traffic between Hamburg and Ahrenburg (1) and were intended to be put into service at the beginning of the summer working (15th May 1936).

The problem the railway wished to solve when designing these trains was to get vehicles of maximum capacity with minimum weight *per seat* and a considerable reduction in the operating costs. The question of railcars or steam trains was unhesitatingly decided in favour of steam as soon as distant control of the locomotive from a compartment of a coach had conferred on the steam train the principal feature of railcar operation, namely immediate reversibility at terminal stations, without shunting.

Fig. 1. — General view of the streamlined double-decker train in use on the Lübeck-Büchen Railway.

The result of the preliminary investigation was a design for a double-decker twin-articulated coach with driving compartments, the inner ends being carried on a common bogie. A 2-4-2 tank engine for working the train was designed on new principles. The locomotive was designed and built by Henschel & Sohn, Cassel, and the double-decker carriages by Linke-Hofmann, Breslau, and Wumag, Görlitz.

Figure 2 gives the principal dimensions of the coach. It seats 300 passengers. There is a driving compartment at each end. At one end next to this compartment there is a luggage compartment in which passengers can put their luggage without charge, a receipt being given them for it.

Train attendants accompany the train to look after passengers. The 300 seats consist of 258 third-class and 42 second. Figure 3 is a diagram of the unit. The total tare

(1) At the time this article was written two such trains had been built.

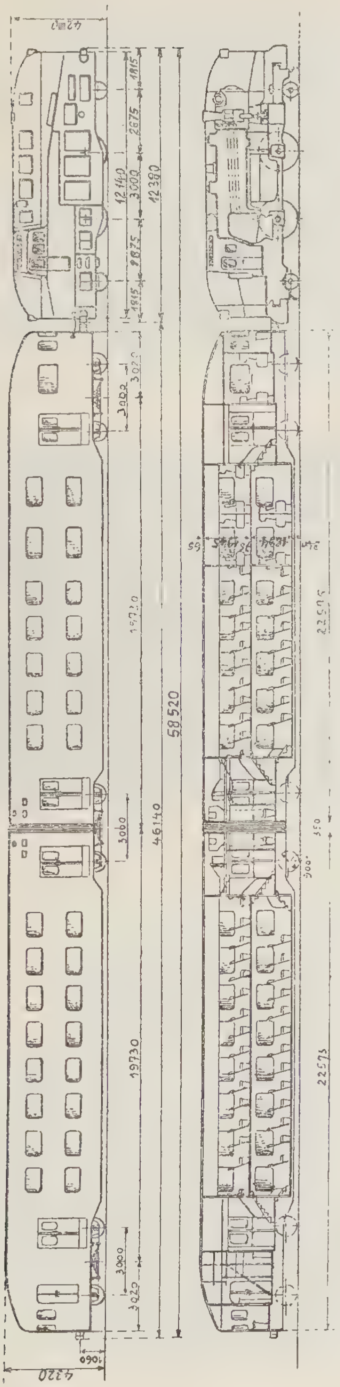

Fig. 2. — Elevation and longitudinal section of the train shown in figure 1 (Locomotive to the right).

weight of the twin-coaches is 71 t. (69.9 Engl. tons) i. e. 236 kgr. (520 lb.) per seat, (the gross weight including the engine is 466 kgr. = 1 027 lb. per seat). The total length including the locomotive is 58.50 m. (192 ft.).

The heating and ventilation equipment provided is designed to heat the air by steam or cool it by iced water, and was supplied by Messrs. Julius Pintsch Ltd., Berlin. In winter the heat exchanger located with the fan and the rest of the equipment above the centre vestibule is steam-heated and warms the air which the fan distributes evenly through the compartments through heating ducts in the angles of the roof of the lower deck. Ventilation ducts are fitted in the window pillars and end in the ducts at the top and bottom. In addition to heating by circulating heated air, provision is made for renewing the air twelve times an hour. The same equipment in summer circulates cool air, iced water being pumped through the heat exchanger from a special tank. Furthermore, in hot weather cold air can be circulated through the vehicle by a fixed plant, the existing ducts being used.

The forced ventilation had to be particularly good as the window lights are fixed in order to make the bodies as simple and light as possible. The body framing is made of St. 52 steel members, which are arc-welded, and is very rigid. The bogie centres are 19.73 m. (64 ft. 9 in.) apart. Figures 4 and 5 are interior views of the twin unit.

The rake was designed for a speed of 120 km. (75 miles) an hour. The time for the 64 km. (40 miles) run between Hamburg and Lübeck is 40 minutes.

The unit is fitted with the Hikpt brake (Knorr Brake Company) with automatic braking in terms of the load.

The vehicle is profusely lighted by dynamos carried on the middle bogie and accumulators under the stairs to the top deck where they are easy to get at.

The locomotive (see figs. 1 and 6) is a 2-4-2 tank engine so as to be suitable for running in either direction. It has a streamlined casing.

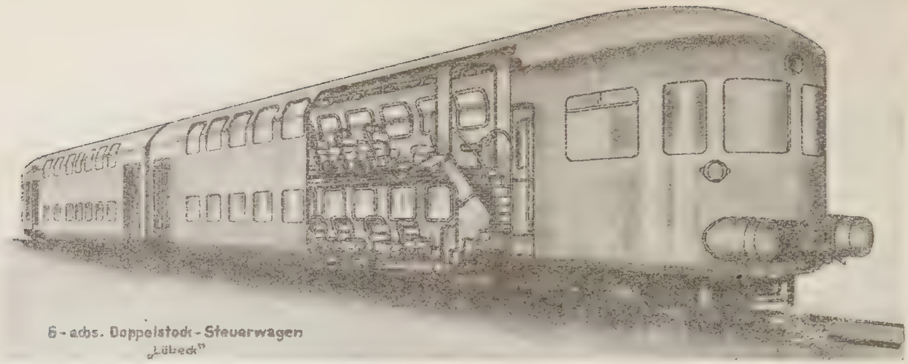

Fig. 3. — Diagrammatic view of the twin articulated unit, with driving compartments, carried on 3 bogies (6 pairs of wheels).

Fig. 4. — Lower section for 2nd-class passengers.

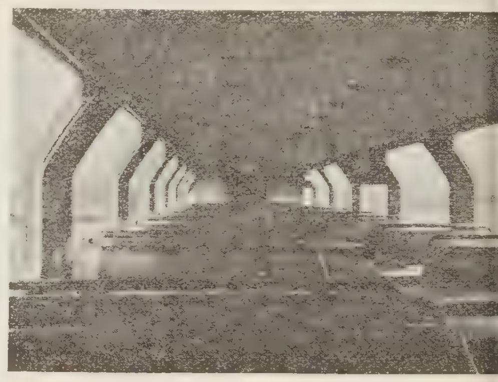

Fig. 5. — Upper section for 3rd-class passengers.

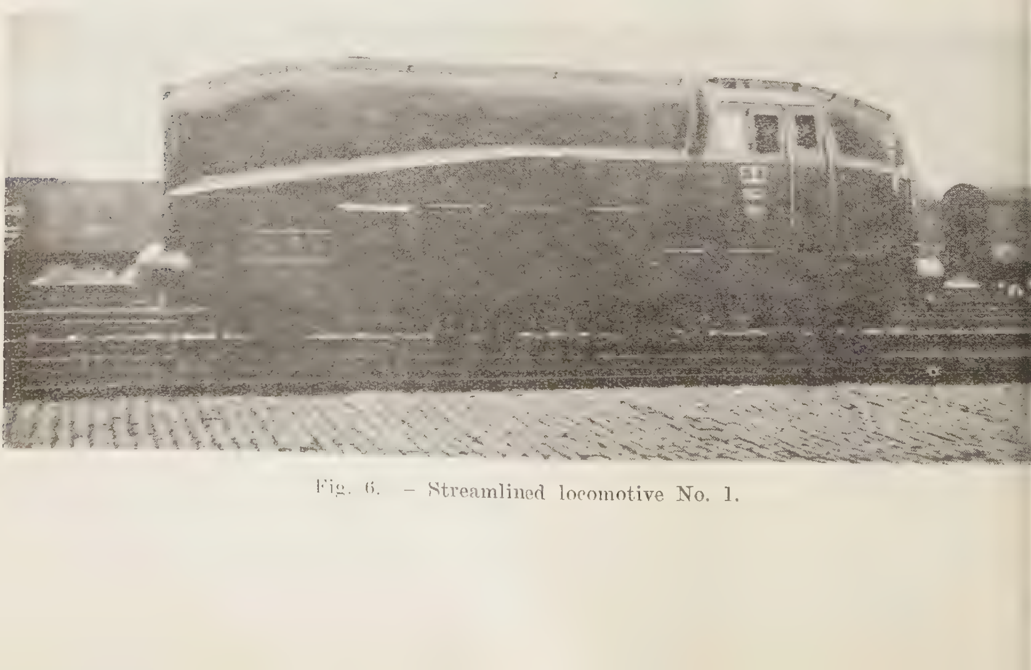

Fig. 6. – Streamlined locomotive No. 1.

Welding has been used on a large scale in building this engine, chiefly to save weight and to increase the water capacity in order to run from Hamburg to Travemünde (84 km. = 52.2 miles) and back without taking water. The boiler pressure is 16 kgr./cm² (227.5 lb. per sq. inch.) and the superheated steam temperature 390° C. (734° F.). The indicated horse-power under steady working conditions is 650. The cylinders are outside and the motion has been given much thought to get a well balanced engine and prevent any vibration getting into the carriages.

The weight of the locomotive is 69 t. (67.9 Engl. tons) in working order, the adhesive weight 37 t. (36.4 Engl. tons) and the maximum axle load 18.5 t. (18.2 Engl. tons).

The distant control gear supplied by Messrs. H. Becker « Elektrobahnen », Berlin, works through an electric motor and chain drive the locomotive regulator which is closed by means of a compressed-air cylinder. This provides in a simple way the equivalent of a « dead mans's » handle as if the control current fails the regulator is closed by compressed air and the quick-acting brake is applied. A loud speaker and a bell between the locomotive and the driving compartments in the coaches completes the distant control equipment.

NEW BOOKS AND PUBLICATIONS.

[656. (.493]

CASTIAU (M.), General Secretary, Ministry of Transport (Belgium). — **Les transports en Belgique et leur coordination** (*Transport in Belgium, and its co-ordination*). — A volume (9 1/2 × 6 1/4 inches) of 264 pages. — 1935, Brussels. Published by the « Comité Central Industriel de Belgique », 33, rue Ducale.

The transport question is a matter of interest in Belgium as elsewhere. An abnormal situation has arisen through the economic crisis during which the volume of traffic has declined progressively, with an increase in road and water transport. The capacity of the available equipment is much greater than the needs. Competition has become intense and endangers the stability of certain undertakings. The railway, a national undertaking, has to protect its traffic and its existence on which depends, moreover, the whole economic position of the country.

The question is very complex owing to the many antagonistic interests involved. The position in Belgium is peculiar as there are two very dense railway systems covering the same territory, namely the standard-gauge lines of the Belgian National Railways Company and the metre-gauge lines of the National Light Railways Company.

The general exposition of the present position as given by Mr. Castiau will be found interesting by many persons preoccupied with the immediate future, not only of the transport companies themselves, but also of industry and commerce. In spite of the steps already taken, such as for instance, the regulation of public motor omnibus and charabanc services and more recently motor goods services, the problem is still far from being solved. Apart from any alterations and additions to be made to existing regulations, the proposals of the Belgium National Railways Company, in connection with the revision of the law of the 25th August 1891 dealing with railway transport and the 1866 specifications for the construction and working of railways under concessions have still to be examined. These claims by the railway were made in order to obtain greater liberty in commercial and operating matters so as to make the fight with road and water transport more equal.

The author first of all deals separately with each form of transport : the standard-gauge railway, the light railway, waterways, roads, and airways. He examines their origins, development, equipment, traffic and capacity and produces statistics obtained from reliable sources, or carefully established and checked. He reveals another form of transport which is not much discussed, is still not serious, but is growing, namely transport « without lines of communication », such as long-distance electric transmission lines, gas mains and oil pipe lines which reduce surface transport of coal and fuel oils.

The problem of competition is dealt with in the two chapters headed « Rail and water competition » and « Rail-road competition ».

In the chapter « The rail-road problem abroad » M. Castiau gives the substance of the regulations and of the co-ordination imposed by law in many European countries and in the United States of America.

Although the author has used many figures to support his arguments in the different chapters, he has considered it useful to group together in a special

chapter entitled « Statistics » the most characteristic and valuable data.

M. Castiau has put the position and given the facts with a strict regard for objectiveness as he promised in the preface. This does not prevent him from expressing his personal opinion on certain aspects of the question. In addition, the opinions or works of other authors are quoted with extracts and their most important conclusions. It may be said, therefore, that this book is impartial and that the investigations have been carried out in such a way as to throw most light on an argument on which public opinion sometimes tends to go astray.

E. M.

[385 .44)]

GODFERNAUX (R.), Ingénieur, Membre du Comité des Travaux Publics des Colonies (Engineer, Member of the Committee for Public Works in the Colonies) (France); Honorary Manager of the *Revue Générale des Chemins de fer.* — **Les grands Réseaux de Chemins de fer français, année 1935** (*The French main-line Railways*, 1935). — A pocket book (7 1/4 × 4 3/4 inches) of 40 pages. — 1936, Paris, Dunod 92, rue Bonaparte.

Mr. R. Godfernaux ended his comments on the 1934 working and the first results of 1935 on a hopeful note. The Public Authorities intervened in railway matters on several occasions, in 1934, and happy results were expected therefrom. Certain operating requirements were lightened; greater freedom in fixing rates was accorded; the transport tax was reduced as from November 1933; and the principles of transport co-ordination were laid down.

1935 was not as good a year as many had hoped. The deficit exceeded that of the previous year and was nearly 4 billions. This figure is chiefly due to financial charges, the actual operating deficit being 400 about millions.

These deplorable results are attributed by the author to the increased severity of the economic crisis and the insufficient protection the railway is given against competition from other forms of transport. On this latter point, the author notes that although during the year considered new decrees were published — such as that instituting a *Higher Coordination Committee* for all transport, that on *road goods transport,* the main provisions of which are given, and a whole sequence of orders on road transport — practically speaking no far reaching application of the principle of coordination has been made. In spite of many demands, the regional agreements negotiated with road passenger service operators have still to pass the last administrative stage, i. e. receive ministerial approval.

Some of the charges affecting the deficit increase year by year; these are the deficits from previous years which have had to be made good from the « common fund ». The total of these withdrawals representing the accumulated deficit since 1921 had reached 23 billions by the 31st December 1934. The author points out that these are « accountancy » deficits in no way due to bad management and have to be set off against the staggering total of 37 billions profits drawn by the State from the railways since 1921.

Mr. Godfernaux briefly reviews the efforts of the main-line railways towards improving their operating methods and meeting the new and marked fall in receipts in 1935. Amongst the measures taken are to be noted the increased mileage worked by railcars (17 820 000 km. against 8 145 000 in 1934). A map of the lines on which the railcars are in

use is very indicative of the importance of this new traction method.

The principal steps taken since 1933 in the general organisation of the main-line railways and in the co-ordination of transport are grouped in a synoptical table. This is followed by a list of the chief events of the year, including all the important decrees affecting railway working.

The statistical tables have been selected very happily; they are all to the point, those giving details of the working accounts as well as those analysing the traffic.

The list of long non-stop runs and high-speed trains brings out very clearly one of the attributes in which rail transport is supreme.

E. M.

[385. (02]

The Universal Directory of Railway Officials and Railway Year Book, 1936-37. — London, The DIRECTORY PUBLISHING Co. Ltd., 33, Tothill Street, Westminster, S. W. 1.; 586 pages (8 1/2 in. × 5 1/2 in.). — **Price** : 20 sh. net.

The Universal Directory of Railway Officials, originally issued in 1895, reaches with the present volume its forty-second year of publication, and its fourth edition incorporating The Railway Year Book.

By fixing the date of issue in the middle of the year it has been found possible to include most of the operating and other figures for the year 1935, and thus give the volume the maximum currency with the latest annual information.

In the new edition opportunity has been taken to include a chronological list of outstanding events in railway history.

The increasing development in the electrification of main-line steam railways has again necessitated revision of the tabulated information on this subject, and the table of the world's total railway mileage has been completely overhauled and amended from official replies to a questionnaire.

Many important overseas changes in organisation during the year have been noted, for example, the nationalisation of the Turkish railways, and these are suitable covered in the new edition.

This year there are three indexes, namely : (1) an index to countries; (2) a general index, including all references to railways and statistical and other information; and (3) a personal index of railway officials.

The lists of railway officials remain, brought up to date, together with brief descriptions of the chief railway governmental and other authorities exercising control over railways.

[385 (06 111]

OFFICIAL INFORMATION

ISSUED BY THE

PERMANENT COMMISSION

OF THE

International Railway Congress Association

Meeting of the Permanent Commission, held on the 11th July, 1936.

The Permanent Commission of the International Railway Congress Association met on the 11th July last in the Assembly room of the Belgian National Railways Head Offices, at Brussels.

* * *

Mr. Rulot, *President,* was in the chair. On opening the meeting, he paid a tribute to the memory of two members of the Permanent Commission, whose death occurred since the previous meeting in 1935 :

Mr. Gustav Behrens, Director, London Midland and Scottish Railway, who had been appointed an honorary member of the Permanent Commission in 1929, in recognition of his long and ceaseless collaboration to the work of this Commission, and passed away in April 1936, at the age of 90;

Mr. Georges Philippe, Inspecteur Général des Lignes Nord-Belges, who died in August 1935, and was also one the oldest and most assiduous members of the Permanent Commission.

Obituary notices recalling the life of these two departed members were published in the three editions of the Monthly Bulletin of the Association (May 1936 and December 1935, English edition).

The Meeting then elected the following Gentlemen as Members of the Permanent Commission :

The Hon. E. C. G. Cadogan, director, Great Western Railway, England;
and Messrs. :

de Spirlet, Inspecteur Général des Lignes Nord-Belges;

Clement, President, Pennsylvania Railroad, U. S. A.;

Nobili, Vice-Directeur Général des Chemins de fer de l'Etat, Italy;

Ottone, President, Federazione Nazionale Fascista degli esercenti imprese ferroviarie, tramviarie e di navigazione, Italy;

Pellarin, Directeur de la Compagnie des Chemins de fer de l'Est, France;

Surleau, Directeur des Chemins de fer d'Alsace et de Lorraine, France;

Tomiyama, Manager of the Japanese Government Railways' Berlin Office;

YOVITCH, Directeur Général Adjoint des Chemins de fer, Jugoslavia,

who respectively take the place of Lord CHURCHILL and Mr. PHILIPPE (deceased), and of Messrs. ATTERBURY, CHIOSSI, MARCHI, RIBOUD, BAUER, KAWAI and ILITCH, who resigned (Clause 6 of the Rules and Regulations).

The following Gentlemen were then, in accordance with previous practice, made temporary members of the Permanent Commission, in their capacity of Members of the Executive Committee of the French Local Organizing Commission of the Paris Congress (1937) :

MM. VIGNAU, Ingénieur en Chef Adjoint de l'Exploitation des Chemins de fer d'Alsace et de Lorraine;

BARTH, Ingénieur en Chef attaché à la Direction du Réseau de l'Est;

PORCHEZ, Chef du Service de la Voie, des Bâtiments et de la Construction des lignes nouvelles du Réseau de l'Etat;

CAMBOURNAC, Ingénieur en Chef des Travaux et de la Surveillance du Réseau du Nord;

DE BOYSSON, Sous-Directeur du Réseau P.O.-Midi;

MARTINET, Ingénieur en Chef attaché à la Direction du Réseau P. L. M.;

DELILLE, Directeur de la Société Générale des Chemins de fer économiques;

Paul MARTIN, Administrateur-Délégué, Directeur Général du Chemin de fer Métropolitain de Paris;

BACQUEYRISSE, Administrateur, Directeur Général de l'Exploitation et des Services Techniques de la S. T. C. R. P.;

BUGNIET, Directeur Régional à Paris de la Compagnie Internationale des Wagons-Lits.

Several of these new Members attended the Meeting.

* * *

The statement of receipts and expenditure for the year 1935 was approved by the Meeting ; the provisional budget drawn up for the year 1936 showed that the financial position of the Association was quite satisfactory.

As a result, and notwithstanding the increased expenditure to be met for the Paris Session, in 1937, it was decided that the rate of the variable part of the yearly contribution will remain 0.10 gold-franc per kilometre for the coming financial year, the maximum rate laid down by the Rules and Regulations being 0.20 gold-franc per kilometre.

* * *

The Meeting heard a report by Mr. GHILAIN, General Secretary, and another by Mr. DE BOYSSON, Chairman of the Executive Committe of the French Local Organizing Commission of the 1937 Congress, in connection with the preliminary arrangements for this Session.

It was found that the work was proceeding satisfactorily as regards the drawing up of the various reports (37), their publication in the three Editions of the Monthly Bulletin and their distribution in due time to the delegates; also that the invitations to the various Governments, Railway Administrations and other Organisations requesting them to name their delegates were about to be sent out.

On the other hand, Mr. DE BOYSSON supplied some interesting information as regards the accommodation for the plenary

and sectional meetings, the program (daily routine) during the Session (31st May to 12th June), the various technical visits and other outings which will be organised for the delegates during or after the Congress.

Mr. de Boysson further stated that detailed questionnaires would be sent in due course to all registered Delegates, with a view to their participation in the receptions, excursions, etc., and the booking of hotel rooms; also that the International Sleeping-Car Company is prepared to act as the medium between Delegates and hotels.

He finally stated that the Executive Committee was preparing the cover of the membership cards, which will serve as a free pass on all French railways, and the badge which will confer free transport on the Paris Metropolitan Railway, motor buses, etc. for the Delegates and accompanying ladies.

* * *

The President reminded the Meeting that the Executive Committee had decided to submit to the Plenary Meeting of the 1937 Congress a proposal tending to revise the Rules and Regulations of the Association so as to simplify the formalities in connection with the alterations to be made to the list of countries covered by the Association. Two schemes were drawn up and submitted to the Members of the Permanent Commission. The Executive Committee favoured the second scheme, which was then laid before the Meeting for examination.

This text was ratified. Its purport is that the list of countries covered by the Association can be altered by a written vote of the Permanent Commission. It was understood, however, that such alterations would, as far as possible, be submitted to a Meeting of the Permanent Commission.

* * *

The Meeting was then acquainted with the alterations which occurred in the menbership of the Association since the Meeting held on the 4th July 1935. They are few in number : two French Colonial Railways applied for membership; one Government (Irish Free State) and two Secondary Railway Companies resigned.

Admissions :

	Km.	Miles.
Chemins de fer de l'Afrique Equatoriale française	1 014	*(630)*
Chemins de fer de Madagascar.	759	*(472)*
Total. . .	1 773	*(1 102)*

Resignations :

	Km.	Miles.
1. *Government :*		
Irish Free State (yearly contribution : 100 gold-francs).		
2. *Railways :*		
Chemins de fer de l'Est de Lyon	104	*(65)*
Régie Départementale des Chemins de fer et Tramways électriques des Bouches-du-Rhône.	175	*(109)*
Total. . .	279	*(174)*

As a result, the aggregate length of lines worked by affiliated Administrations shows a slight increase.

The Railway Congress Association at present includes 195 Administrations with a total mileage of 327 110 (526 417 km.).

P. Ghilain. N. Rulot.
General Secretary. *President.*

List of Members of the Permanent Commission

OF THE

INTERNATIONAL RAILWAY CONGRESS ASSOCIATION

(11th July, 1936).

President :

N. **Rulot** [3], directeur général de la Société Nationale des Chemins de fer belges; 74, rue du Progrès, Brussels.

Vice-Presidents :

U. **Lamalle** [2], directeur général adjoint, directeur de l'exploitation à la Société Nationale des Chemins de fer belges; 17, rue de Louvain, Brussels;

R. **Le Besnerais** [1], directeur de l'exploitation de la Compagnie du Chemin de fer du Nord français; 18, rue de Dunkerque, Paris.

Members of the Executive Committee :

Grimpret [2], secrétaire général du Ministère des Travaux publics, chargé de la Direction des chemins de fer: 244, boulevard Saint-Germain, Paris;

The Right Hon. Lord **Rockley** [1], P. C., G. B. E., director, Southern Railway; 2, Cadogan Square, London, S. W. 1;

D. **Vickers** [3], director, London Midland & Scottish Railway; Chapel House, Charles Street, Berkeley Square, London, W. 1.

Ex-president of session, member ex-officio :

H. E. Ibrahim Fahmy **Kerim** Pasha, Minister of Communications of Egypt; Cairo.

Members :

F. **Besser** [1], Ministerialrat, Reichsverkehrsministerium; 80, Wilhelmstrasse, Berlin, W. 8;

The Hon. E. C. G. **Cadogan** [2], C. B., M. P., director, Great Western Railway; Board Room, Paddington Station, London W. 2;

J. **Castiau** [2], secrétaire général du Ministère des Transports de Belgique; 17a, rue de la Loi, Brussels;

H. E. Mahmoud **Chaker Pasha** [3], under secretary of State, General Manager of the Egyptian State Railways; Cairo;

M. W. **Clement** [1], president, Pennsylvania Railroad; Broad Street Station, Philadelphia;

R. **da Costa Couvreur** [1], ingénieur-inspecteur, secrétaire général au Ministère des Travaux publics et des Communications du Portugal; Rua Chaby Pinheiro, N° L. V. G., 2, 1°, Lisbon;

Dautry [3], directeur général des chemins de fer de l'Etat français; 20, rue de Rome, Paris;

Sir Francis **Dent** [3], C. V. O., director, Southern Railway (Great Britain); Dock House, Beaulieu (Hants), England;

de Ruffi de Pontevès [2], inspecteur général des mines, directeur du contrôle du travail des agents du chemin de fer, Ministère des Travaux publics; Paris;

Dr. Othon **de Senn** [1], secrétaire d'Etat, président de la Direction des Chemins de fer royaux de l'Etat hongrois; 73, Andràssy ut, Budapest VI;

de Spirlet [3], inspecteur général des lignes Nord belges; Liége;

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(1) Retires at the 13th session.
(2) Retires at the 14th session.
(3) Retires at the 15th session.

Dr. J. **Dorpmüller** (1), Generaldirektor der Deutschen Reichsbahngesellschaft; 35, Voss-Strasse, Berlin W. 8;

F. **Fiori** (1), ingénieur, administrateur des chemins de fer de l'Etat italien; Villa Patrizi, Rome;

Sir Henry **Fowler** (2), K. B. E., chairman of Committee, Ministry of Transport, Great Britain; Spondon Hall, near Derby;

P. **Ghilain** (2), ingénieur en chef au service du matériel de la Société Nationale des chemins de fer belges; 74, rue du Progrès, Brussels;

A. **Granholm** (2), directeur général des chemins de fer de l'Etat suédois; Stockholm;

Sir H. Nigel **Gresley** (2), K. B. E., D. Sc., chief mechanical engineer, London & North Eastern Railway; King's Cross Station, London, N. 1;

Grimpret (2) (already named).

Ch. **Gufflet** (3), directeur de la Compagnie des Chemins de fer du Midi; 54, boulevard Haussmann, Paris;

Sir Hugh **Hannay** (3), agent, East Indian Railway; « Marlposts », Tarring (Sussex);

R. J. **Harvey** (3), consulting engineer to the Government of New-Zealand; 34, Victoria Street, Westminster, London, S. W. 1;

A. **Henry-Gréard** (3), directeur de la Compagnie du chemin de fer de Paris à Orléans; 8, rue de Londres, Paris;

H. **Hunziker** (1), ingénieur, directeur de l'Office fédéral des transports; Berne;

Sir Cyril **Hurcomb** (1), K. B. E., C. B., secretary to the Ministry of Transport (Great-Britain); 6, Whitehall Gardens, London, S. W. 1;

L. **Jacobs** (1), directeur général de la Société Nationale belge des Chemins de fer Vicinaux; 14, rue de la Science, Brussels;

G. **Jadot** (1), directeur du service des finances de la Société Nationale des Chemins de fer belges; 21, rue de Louvain, Brussels;

H. **Jezierski** (1), conseiller ministériel au Ministère des Communications de Pologne; Warsaw;

E. **Kejr** (3), ingénieur, conseiller ministériel, chef du département V/5 au Ministère des chemins de fer de Tchécoslovaquie; Prague;

H. E. Ibrahim Fahmy **Kerim** Pasha (already named);

Dr. Th. **Kittel** (2), Reichsbahndirektor, Mitglied der Hauptverwaltung der Deutschen Reichsbahngesellschaft; 35, Voss-Strasse, Berlin, W. 8;

P. **Knutzen** (3), directeur général des Chemins de fer de l'Etat danois; 40, Sölvgade, Copenhagen, K.;

U. **Lamalle** (already named);

R. **Le Besnerais** (already named);

C. **Lemaire** (1), directeur du service de la voie de la Société Nationale des Chemins de fer belges; 17, rue de Louvain, Brussels;

L. F. **Loree** (3), president, Delaware & Hudson Railroad; 32, Nassau Street, New York City;

A. **Mange** (1), administrateur de la Compagnie du chemin de fer de Paris à Orléans, président du Comité de gérance de l'Union internationale des chemins de fer; 42, rue de la Bienfaisance, Paris;

A. **Marguerat** (1), directeur des Compagnies de chemins de fer de Viège à Zermatt, Furka-Oberalp, Gornergrat et Schöllenen; Lausanne;

E. **Maristany** (3), marquis d'Argentera, directeur général de la Compagnie des chemins de fer de Madrid à Saragosse et à Alicante; Estación de Atocha, Madrid;

C. **Mereutza** (2), directeur général des Chemins de fer de l'Etat roumain; Bucharest;

(1) Retires at the 13th session.
(2) Retires at the 14th session.
(3) Retires at the 15th session.

L. **Moralès** (²), vice-président du Conseil supérieur des chemins de fer d'Espagne, président du Conseil d'administration des chemins de fer de l'Ouest de l'Espagne; Estación de las Delicias, Madrid;

J. **Moreno Ossorio** (¹), Administrateur à la Commission permanente du Comité exécutif des Chemins de fer du Nord de l'Espagne; Estación del Norte, Madrid;

E. **Mugniot** (³), directeur général de la Compagnie des Chemins de fer de Paris à Lyon et à la Méditerranée; 88, rue St-Lazare, Paris (9e);

B. **Nobili** (³), ingénieur, vice-directeur général des Chemins de fer de l'Etat italien; Rome;

H. E. Mohamed **Osman** Bey (³), under secretary of State, Egyptian Ministry of Communications; Cairo;

G. **Ottone** (¹), président de la Federazione Nazionale Fascista degli Esercenti Imprese ferroviarie, Tramviarie e di Navigazione; 115, Piazza Montecitorio, Rome;

Pellarin (²), directeur de la Compagnie des Chemins de fer de l'Est français; 21-23, rue d'Alsace, Paris;

J. J. **Pelley** (³), President, Association of American Railroads, Transportation Building; Washington D. C.;

C. **Ramallo** (²), ingénieur, director del Instituto de Economia de los Transportes, Facultad Nacional de Ciencias Económicas; Buenos Ayres;

Dr. W. **Rauscher** (²), conseiller ministériel, directeur commercial des Chemins de fer fédéraux autrichiens; Vienna;

The Right Hon. Lord **Rockley**, P. C., G. B. E. (already named);

N. **Rulot** (already named);

A. **Schrafl** (²), président de la Direction générale des chemins de fer fédéraux suisses; Berne;

G. **Sgoureff** (²), ingénieur, directeur général adjoint des Chemins de fer et des Ports de l'Etat bulgare; Sofia;

Sir Josiah **Stamp** (²), G. B. E., D. Sc., chairman and president of the Executive, London Midland & Scottish Railway; Euston Station, London N. W. 1;

Surleau (²), directeur des Chemins de fer d'Alsace et de Lorraine; 3, boulevard du Président Wilson, Strasbourg;

T. C. **Swallow** (³), advisory engineer, Office of the High Commissioner for the Union of South Africa; South Africa House, Trafalgar Square, London, W. C. 2;

R. E. **Thomas** (³), deputy general manager, Egyptian State Railways; Cairo;

K. **Tomiyama** (²), secretary of the Japanese Ministry of Railways, manager of its Berlin Office; 11, von der Heydt Strasse, Berlin W. 35.

Antonio **Valenciano** y **Mazerès** (²), inspecteur général des ponts et chaussées, administrateur de la Compagnie des Chemins de fer de Madrid à Saragosse et à Alicante; 5-3°, General Oraâ, Madrid;

H. **van Manen** (¹), directeur des Chemins de fer néerlandais; Utrecht;

Th. M. B. **van Marle** (³), inspecteur général des chemins de fer et tramways néerlandais; 25, Koningskade, The Hague;

L. **Velani** (¹), directeur général des Chemins de fer de l'Etat italien; Villa Patrizi, Rome;

A. M. M. **Verkoyen** (³), directeur du service du matériel de la Société Nationale des Chemins de fer belges; 17, rue de Louvain, Brussels;

D. **Vickers** (already named);

Dr. C. C. **Wang** (²), representative of the Chinese Ministry of Railways; 21, Tothill Street, Westminster, London, S. W. 1;

(¹) Retires at the 13th session.
(²) Retires at the 14th session.
(³) Retires at the 15th session.

Sir Ralph Lewis **Wedgwood** (1), C. B., C. M. G. chief general manager, London & North Eastern Railway; King's Cross Station, London, N. 1;

D. **Willard** (1), chairman of the Board, Association of American Railroads, president, Baltimore et Ohio Railroad; Baltimore, Md.;

M. **Yoyitch** (2), directeur général adjoint des chemins de fer; Belgrade;

N... (1) (Brazil);

N... (2) (Germany);

N... (3) (Germany).

N... (3) (Germany).

Honorary member : C. **Colson**, membre de l'Institut, inspecteur général des Ponts et Chaussées, vice-président honoraire du Conseil d'Etat de France, membre du Conseil supérieur des chemins de fer de France; 2, rue de Laplanche, Paris.

Temporary Members of the Permanent Commission. (Executive Committee of the French Local Organising Commission of the Paris Session, 1937) :

Bacqueyrisse, administrateur, directeur général de l'Exploitation et des Services techniques de la Société des Transports en Commun de la Région Parisienne; 53ter, quai des Grands-Augustins, Paris (6e);

Barth, ingénieur en chef attaché à la Direction de la Compagnie des Chemins de fer de l'Est français; 21-23, rue d'Alsace, Paris (10e);

Bugniet, directeur régional de la Compagnie Internationale des Wagons-Lits et des Grands Express Européens; 5, place des Vosges; Paris (4e);

Cambournac, ingénieur en chef des Travaux et de la Surveillance de la Compagnie du Chemin de fer du Nord français; 18, rue de Dunkerque, Paris (10e);

de Boysson, sous-directeur de la Compagnie des Chemins de fer P. O.-Midi; 8, rue de Londres, Paris (9e);

Delille, directeur de la Société Générale des Chemins de fer Economiques; 4, Cité de Londres, 13, rue de Londres, Paris (9e);

P. **Martin**, administrateur-délégué, directeur général de la Compagnie du Chemin de fer Métropolitain; 75, boulevard Haussmann, Paris (8e);

Martinet, ingénieur en chef attaché à la Direction de la Compagnie des Chemins de fer de Paris à Lyon et à la Méditerranée; 88, rue Saint-Lazare, Paris;

Porchez, chef du Service de la Voie, des Bâtiments et de la Construction des Lignes nouvelles des Chemins de fer de l'Etat français; 21, rue d'Amsterdam, Paris;

Vignau, ingénieur en chef adjoint de l'Exploitation des Chemins de fer d'Alsace et de Lorraine; 3, boulevard du Président Wilson, Strasbourg.

SECRETARY'S OFFICE : 74, rue du Progrès, Brussels.

General secretary : P. **Ghilain** (already named).

Assistant secretaries : A. W. **Chantrell**, ingénieur principal à la Société Nationale des Chemins de fer belges;

E. **Minsart**, ingénieur principal à la Société Nationale des Chemins de fer belges;

R. **Desprets**, ingénieur principal à la Société Nationale des Chemins de fer belges.

(1) Retires at the 13th session.
(2) Retires at the 14th session.
(3) Retires at the 15th session.